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OFFICE OF EXPERIMENT STATIONS
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PROCEEDINGS

OF THE

FOURTEENTH ANNUAL CONVENTION

OF THE ASSOCIATION OF

American Agricultural Colleges and Experiment Stations

HELD AT

NEW HAVEN AND MIDDLETOWN, CONN.
NOVEMBER 13–15, 1900

EDITED BY

A. C. TRUE and W. H. BEAL, for the Office of Experiment Stations

AND

H. H. GOODELL, for the Executive Committee of the Association

WASHINGTON
GOVERNMENT PRINTING OFFICE
1901

THE AGRICULTURAL COLLEGES.

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MASSACHUSETTS—*Amherst:* Henry H. Goodell.*

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OHIO—*Columbus:* William Oxley Thompson.*

OKLAHOMA—*Stillwater:* Angelo C. Scott.*
Langston: Inman E. Page.

OREGON—*Corvallis:* Thos. M. Gatch.*

PENNSYLVANIA—*State College:* George W. Atherton.*

RHODE ISLAND—*Kingston:* John H. Washburn.*

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Hampton: H. B. Frissell.*

WASHINGTON—*Pullman:* E. A. Bryan.*

WEST VIRGINIA—*Morgantown:* Jerome H. Raymond.* *Institute:* J. McHenry Jones.*

WISCONSIN—*Madison:* Charles K. Adams.*

WYOMING—*Laramie:* Elmer E. Smiley*.

---

* President. † Chancellor.

U. S. DEPARTMENT OF AGRICULTURE

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1901

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., May 6, 1901.

Sir: I have the honor to transmit herewith for publication Bulletin No. 99 of this Office, containing the proceedings of the Fourteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at New Haven and Middletown, Conn., November 13–15, 1900.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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OFFICERS AND COMMITTEES OF THE ASSOCIATION.

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E. A. BRYAN, of Washington.

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E. B. VOORHEES, of New Jersey.

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A. C. TRUE, of Washington, D. C.

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Ex officio: The PRESIDENT; the JUNIOR EX-PRESIDENT (J. E. STUBBS); the SECRETARY.

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C. D. WOODS, of Maine, *Chairman;* H. J. WATERS, of Missouri, *Secretary.*

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H. W. TYLER, of Massachusetts, *Chair.;* F. P. ANDERSON, of Kentucky, *Secretary.*

STANDING COMMITTEES.

Indexing Agricultural Literature,

A. C. TRUE, of Washington, D. C., *Chair.;* T. F. HUNT, of Ohio;
W. M. HAYS, of Minnesota; E. DAVENPORT, of Illinois;
JOSEPHINE A. CLARK, Librarian, U. S. Dept. of Agriculture.

Methods of Teaching Agriculture,

J. H. CONNELL, of Texas, *Chairman;* A. C. TRUE, of Washington, D. C.
T. F. HUNT, of Ohio; H. T. FRENCH, of Idaho;
H. H. WING, of New York.

Graduate Study at Washington,

C. Northrop, of Minnesota, *Chairman;* J. E. Stubbs, of Nevada;
M. H. Buckham, of Vermont; A. C. True, of Washington, D. C.;
J. H. Washburn, of Rhode Island; C. W. Dabney, of Tennessee;
W. O. Thompson, of Ohio.

Uniform Fertilizer Laws,

H. J. Wheeler, of Rhode Island, *Chair.;* H. P. Armsby, of Pennsylvania;
C. D. Woods, of Maine; E. H. Jenkins, of Connecticut;
M. A. Scovell, of Kentucky.

Military Instruction in Land-Grant Colleges,

G. W. Atherton, of Pennsylvania, *Chair.;* Alexis Cope, of Ohio;
A. W. Harris, of Maine; H. H. Goodell, of Massachusetts;
C. W. Dabney, of Tennessee; R. H. Jesse, of Missouri;
H. C. White, of Georgia.

Cooperation between Stations and U. S. Department of Agriculture,

E. A. Bryan, of Washington, *Chairman;* W. A. Henry, of Wisconsin;
H. H. Goodell, of Massachusetts; H. J. Waters, of Missouri;
L. G. Carpenter, of Colorado.

Revision of Constitution,

J. E. Stubbs, of Nevada, *Chairman;* J. K. Patterson, of Kentucky;
M. H. Buckham, of Vermont; W. A. Henry, of Wisconsin;
H. H. Goodell, of Massachusetts.

Pure-Food Legislation,

W. A. Withers, of North Carolina, *Chair.;* H. J. Patterson, of Maryland;
W. Frear, of Pennsylvania; H. J. Wheeler, of Rhode Island;
A. T. Neale, of Delaware.

LIST OF DELEGATES AND VISITORS IN ATTENDANCE.

Alabama: P. H. Mell.
Arkansas: R. L. Bennett, V. Y. Cook.
California: C. W. Woodworth.
Colorado: B. O. Aylesworth, L. G. Carpenter, B. F. Rockafellow, Mrs. B. F. Rockafellow.
Connecticut: W. O. Atwater, W. H. Brewer, W. E. Britton, G. W. Flint, W. D. Holman, E. H. Jenkins, C. Langley, A. B. Morrill, C. S. Phelps, W. C. Sturgis, A. L. Winton.
Delaware: G. A. Harter.
Florida: W. F. Yocum.
Georgia: R. J. Redding, H. C. White.
Illinois: S. A. Forbes, A. McLean.
Kansas: E. R. Nichols.
Kentucky: F. P. Anderson, Mrs. F. P. Anderson, H. Garman, J. K. Patterson, Mrs. J. K. Patterson, M. A. Scovell, Mrs. M. A. Scovell.
Maine: M. C. Fernald, A. W. Harris, L. H. Merrill, C. D. Woods.
Maryland: W. G. Johnson, J. R. Owens, H. J. Patterson.
Massachusetts: W. P. Brooks, H. T. Fernald, H. H. Goodell, H. W. Tyler.
Michigan: C. J. Monroe, J. L. Snyder.
Minnesota: W. M. Hays, W. M. Liggett.
Mississippi: J. C. Hardy, W. R. Perkins.
Missouri: H. J Waters.
Montana: F. W. Traphagen.
Nebraska: E. B. Andrews, T. L. Lyon.
Nevada: S. B. Doten, J. E. Stubbs, Mrs. J. E. Stubbs.
New Hampshire: C. W. Burkett, C. S. Murkland, F. W. Rane.
New Jersey: B. D. Halsted, A. Scott, J. B. Smith, E. B. Voorhees.
New Mexico: J. J. Vernon.
New York: S. A. Beach, J. Craig, E. P. Felt, B. Von Herff, Mrs. B. Von Herff, Miss Hyden, W. H. Jordan, J. S. Meng, J. A. Myers, W. Plunkett, I. P. Roberts, F. A. Sirrine.
North Carolina: B. W. Kilgore, G. T. Winston.
North Dakota: E. F. Ladd, J. H. Worst.
Ohio: A. Cope, T. H. Hunt, W. O. Thompson, C. E. Thorne, Mrs. C. E. Thorne, R. H. Warder.
Oklahoma: E. E. Bogue, J. Fields.
Oregon: J. Withycombe.
Pennsylvania: H. P. Armsby, G. W. Atherton.
Rhode Island: G. E. Adams, A. A. Brigham, F. W. Card, B. L. Hartwell, J. H. Washburn, H. J. Wheeler.
South Carolina: R. N. Brackett, H. S. Hartzog, T. E. Miller.
South Dakota: J. W. Heston.
Tennessee: C. W. Dabney.

Vermont: M. H. Buckham, J. L. Hills.
Washington: E. A. Bryan.
West Virginia: J. H. Raymond.
Wisconsin: S. M. Babcock, W. A. Henry.
Wyoming: E. E. Smiley.
U. S. Department of Agriculture: A. C. True and E. W. Allen, of the Office of Experiment Stations; M. Whitney, of the Division of Soils; T. A. Williams, of the Division of Agrostology; J. G. Smith, of the Section of Seed and Plant Introduction.
Bonn-Poppelsdorf, Germany: O. Hagemann.
London, England: B. Dyer.

PROCEEDINGS OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

MINUTES OF THE GENERAL SESSION.

Morning Session, Tuesday, November 13, 1900.

The convention was called to order in the Assembly Hall of Sheffield Scientific School of Yale University at 9.45 a. m., President Joseph E. Stubbs, of Nevada, in the chair. Prayer was offered by President W. O. Thompson, of Ohio.

The chairman of the executive committee read the following report:

Report of Executive Committee.

Immediately following adjournment of the last convention, the executive committee met and organized for the year, making choice of E. B. Voorhees for secretary, and H. H. Goodell for chairman.

The duties intrusted to it, involving interests affecting the very existence of each experiment station and the material prosperity of each college, have proved exceedingly arduous, and but for the assistance promptly given by members of the Association could not have been performed.

In accordance with the resolution directing your committee to make earnest effort to secure places on the programme of the National Educational Association for 1900 in order to present the mission and scope of the land-grant colleges in the American system of education, a prolonged correspondence was entered into with the different officers of the Association. An assignment of place was finally made in the section of higher education, and President Beardshear, of Iowa, was appointed to represent our Association. This duty he performed at the annual meeting held in Charleston, S. C.

Learning that a bill (S. 3181) "to amend the act relating to the public printing and binding and distribution of public documents" was being considered, your committee promptly appeared before the chairman of the Committee on Printing, urging that all the land-grant colleges should be constituted designated depositories of Government publications. An additional section, No. 9, was incorporated in the bill, reading as follows: "That the library of any college established for the benefit of agriculture and the mechanic arts in accordance with the provisions of the acts of Congress approved July 2, 1862, and August 30, 1890, shall be constituted a designated depository of Government publications, and the superintendent of documents shall supply one copy of said publications, in the same form as supplied to other depositories, to such library, and the Public Printer shall print, bind, and deliver to the superintendent of documents such extra number of documents as will enable him to comply with the provisions of this section."

The amended bill was reported on May 17 and is now on the Senate calendar for next session, Order No. 1322. As unfinished business it should be taken up by the next executive committee and carried to a successful issue. Twenty-five only of the land-grant colleges are now designated depositories, charged to the Representatives in Congress from the respective districts in which located. Under the present law any depository may be dropped at the pleasure of the member of Congress to whom it is charged. The effect of this amendment is to make every land-grant college a designated depository by law, thus insuring permanency.

It will be recalled that in the Fifty-fourth Congress a free-homestead bill, introduced as a rider to the Indian appropriation bill, was hotly debated. This bill, it

was believed, gave to settlers free of charge land upon the sale of which depended the Morrill annuity to the land-grant colleges and the annual appropriation to the agricultural experiment stations. The friends of both rallied quickly to their support. It was passed in the Senate, but lost in the House. In the closing hours of the session the conferees compromised and agreed to extend the time of payment two years for land actually entered and taken up by settlers. In the Fifty-fifth Congress a similar attempt was made to introduce the measure as a rider to one of the large appropriation bills in the Senate, but the attempt was frustrated. Promptly with the opening of the Fifty-sixth Congress the free-homestead bill was introduced into the House. Its friends agreed with your committee to insert an amendment, providing that if at any time the proceeds of the sale of public lands was insufficient to meet the annual appropriations to the land-grant colleges and experiment stations the same should be paid from the Treasury of the United States. As thus amended the bill passed with slight opposition in the House and none in the Senate. The Association is to be congratulated that at last this source of income has been placed upon so absolutely sure a foundation.

The bill establishing schools or departments of mining and metallurgy in connection with the colleges for the benefit of agriculture and the mechanic arts very early attracted the attention of your committee. Had a choice been made no better time could have been selected. There appeared to be a widespread interest in the subject. No less than four different bills creating schools of mines were in the field. They were for the most part, however, local and not general. To harmonize the various interests and produce a bill universal in its application and yet just and acceptable to all was the task of your committee. Its aim, furthermore, was to build on the foundations already laid under the acts of 1862 and 1890, and thus enable these new schools to take advantage of the buildings, apparatus, and equipment already accumulated, believing that in this way alone could be secured that most desirable end of maximum advantage at minimum cost.

The Senate Committee on Mines and Mining, to which the bill was referred, gave a full hearing, and, with a few amendments, reported back the bill favorably, in charge of Mr. Tillman, of South Carolina. After brief discussion it was laid on the table to allow the amendments to be printed, and was subsequently passed without a dissenting vote. On reaching the House it was referred to the Committee on Mines and Mining, and after another hearing was reported on favorably and placed in charge of Mr. Mondell, of Wyoming, who generously relinquished a bill of similar tenor which he had previously introduced.

The pressure of business at the close of the session prevented its reaching a vote, and it now remains on the House Calendar, S. 3982, awaiting final action.

The advantages accruing to each institution represented in this Association are too apparent to be mentioned, but we may, perhaps, be pardoned for quoting the comprehensive language of section 2, enumerating the various branches that may be taught: "That said appropriations shall be expended only for geological instruction, mining engineering, metallurgy, research in road-building material and its proper application, and the branches of learning pertaining thereto, including the various branches of physical, natural, and economic science, and the facilities for such instruction, research, and experiment in order to promote a liberal and practical education and secure the most intelligent use, conservation, and development of the mineral resources of the country." Surely nothing could be more liberal than this interpretation of the needs of a school of mines.

The executive committee at the last convention was directed to confer with the Secretary of Agriculture with reference to the publication of the papers presented before the several sections of the Association. It was found on examination that the present laws permitted the publication of such papers as were considered worthy, and it was deemed unnecessary to hold the conference as directed.

Complaint having been made that public documents frequently did not reach designated depositories until two or three years after their first printing, the executive committee was directed to bring the subject to the attention of the proper committees of the two branches of Congress. A memorial has been addressed to the chairman of the House Committee on Printing, and the superintendent of public documents has advised us that steps have been taken to prevent that delay.

A matter of vital importance to the interests of our Association demands a few words. Repeated violations of our postal privileges, presumably through ignorance or carelessness, have been brought to our notice. A report of a State board of agriculture was mailed under a bulletin frank. Catalogues of colleges, containing nothing but names of students and courses of study, have been sent in the same manner, and letters have been franked under the guise of newspaper bulletins. Gentlemen of the Association, we can not afford to imperil a privilege that saves us annually thousands of dollars!

In closing, your committee desires to offer the following recommendations: (1) That matters of unfinished legislative business be pressed to a conclusion at as early a date as practicable, and (2) that a codification of the postal regulations be made and sent to each president and director urging his strict compliance with the law.

In behalf of the executive committee.

HENRY H. GOODELL, *Chairman.*

On motion, the report was accepted.

On recommendation of the executive committee, it was voted to hold the morning and afternoon sessions of Wednesday, November 14, at Wesleyan University, Middletown, Conn.

Reports of the sections were then called for. No reports from the sections on College Work and Agriculture and Chemistry were presented.

S. A. Beach, of New York, read the following report from the Section on Horticulture and Botany:

REPORT OF SECTION ON HORTICULTURE AND BOTANY.

The work in horticulture and botany will be considered under two heads, namely, instruction and investigation. Let the former include the instruction of college or university students and work with farmers' reading courses, farmers' institutes, the nature-study movement, or along any similar line, and also the preparation of reading matter aside from that which sets forth the results of research. Let efforts to add to the sum total of human knowledge of things botanical or things horticultural be considered under the head of investigation.

Nearly all of the botanists and horticulturists of the institutions included in this Association have frankly replied to the blunt inquiries addressed to them, which courtesy is here thankfully acknowledged with sincere appreciation. Several of them report improved equipment and increased facilities for work, which is indeed gratifying. So far as mention is made of the subject of instruction, the reports indicate that with few exceptions about the same course has been pursued and much the same ground has been covered as in the previous year. Doubtless similar reports are rendered from year to year. Does this mean that no noteworthy progress is being made in this direction? Surely not. New educational features usually develop by rather slow processes of growth. When the work of one season is considered alone or only in comparison with that of the previous year, there may be but little apparent advancement, but let the thought run back over a longer period, as, for example, ten years, and the growth which has been made is brought out more clearly by the comparison. Looking at the changes which have developed during the last decade in the kind of botanical instruction which is given in our agricultural colleges, it is at once apparent that physiological botany receives greater attention now than formerly. Years ago systematic botany, having received a wonderful impetus from the enthusiastic researches of herbalists, came to occupy a position of preeminence in the botanical world. Even less than a generation ago, among the most prominent American botanists there were those who early in their careers had taken the degree of doctor of medicine, and who began their botanical work with the study of medicinal herbs. We can all remember when the colleges offered but little botanical instruction outside of systematic and structural botany and plant morphology. Now physiological botany receives considerable attention. Figuratively speaking, botany is now standing on its morphologico-systematic leg and extending its physiologico-pathological foot to take another step forward. Leaving systematists to dispute as to whether Linnæus or Michaux first published a particular species and to confuse laymen by their multifarious changes of scientific names for old familiar faces, investigators have pushed into the fields of plant physiology, plant pathology, and other formerly neglected botanical territory. As a result of this movement, which is world-wide, and in which America is at no distant day to take the lead, the botanical instruction in American agricultural colleges is being modified in the direction which has just been pointed out. As an example of the way in which the work in vegetable physiology and pathology is coming into greater prominence, let me quote a communication from the botanist of the Massachusetts Agricultural College:

"My laboratory has never been so crowded with elective students; nearly 50 per cent of the seniors have elected botany, besides about ten post graduates who are taking work this year. Vegetable physiology and pathology are pursued during the senior electives, and these branches are receiving considerable attention in post-graduate studies. One-half year is devoted to each, the time being eight hours per week."

In Georgia a movement is on foot for the establishment at the State University of what is called a permanent farmers' institute, in which for eight months of the year those who desire to do so may receive expert instruction in farm practice, farm management, etc. This, as yet only a proposed change, seems to promise peculiar advantages to the youth from the farms who can not take a full college course. If the movement is properly supported it will doubtless help to bring the class of people for whose especial benefit the agricultural college was established into more intimate and friendly relations with the university.

At the University of Missouri a six weeks' summer school in horticulture for the instruction of the teachers in public schools has been permanently organized. The horticulturist says: "For the past four years instruction has been given in the summer school in horticulture, agriculture, and nature studies. This year the attendance was so large and the demands of the teachers so great for work of this character that a permanent six weeks' course in horticulture has been arranged to be given each summer. In many sections of the State the teachers have, through our efforts, organized local societies for the promulgation of the work, and in many cases very fine work was done the past year in planting school gardens and arranging laboratories for winter studies in plant propagation and plant life generally. The department has arranged to send specialists to several centers the coming winter to give sample lessons and to give such impetus to the work as can be done by brief visits."

One of the important efforts to stimulate the educational life of rural communities is that which has come to be known as the nature-study movement. It is mentioned here because botanists and horticulturists of the agricultural colleges are in several States closely identified with it. The extension of nature study into rural communities, either through the common schools or by the organization of children into junior naturalist clubs was, I believe, initiated by Prof. L. H. Bailey. Since an outline of the nature-study movement in New York State has been presented before the Section on Horticulture and Botany no further discussion of the subject will be attempted here.

The efforts emanating from the agricultural colleges for the purpose of reaching the dwellers in rural communities more effectively are increasing in number, and are fast extending into a national movement for the betterment of the farming class. It is essentially the university-extension idea which is being adapted by these institutions to meet in various ways the peculiar needs in their especial field of labor. At Cornell University, Ithaca, N. Y., this kind of work has grown to such proportions that there has recently been organized a department for the farmers' reading course and extension teaching. The number of people in New York who have heretofore been connected with this work is about 20,000. Professor Craig, having resigned his position as horticulturist of the Iowa Agricultural College, assumes charge of this new department, with the title of professor of extension teaching in agriculture and horticulture. The culmination of the farmers' reading course is to be a short course at the university, where the specific instruction needed in agriculture and horticulture will be given as far as possible.

Having thus briefly considered a few of the interesting developments in the work of instruction, we will now give attention to the next division of this report, namely, the work of investigation. In most of the agricultural colleges the botanists and horticulturists of the college are also employed in the experiment stations. Out of forty-eight of the horticulturists who replied to the inquiry as to what portion of their time was given to the experiment station, 66 per cent give from half to all of their time, and of the thirty-four assistants who were mentioned in the replies, 80 per cent give from half to all of their time to the experiment station. Some found it impossible to make more than a rough estimate of the amount of time devoted to college and station work, respectively; others made the indirect reply that nominally or theoretically a certain portion of their time is given to the station. Of those who replied to the further inquiry as to what portion of their time is devoted to investigation, 38 per cent give one-half or more to this work, and 43 per cent of the assistants who were mentioned give one-half or more of their time to investigation.

An attempt was made to discover what are the principal lines along which the horticulturists and botanists are directing their investigations. These are to a great extent shown by the material which appears in the station publications.

Mr. Hall, the librarian at the Geneva station, has very kindly classified for me the matter of botanical or horticultural nature in the station bulletins and reports published since January 1, 1899, which came to hand prior to November 1, 1900. One hundred and forty-eight bulletins are represented in this summary and also six annual reports which contain matter not given in any bulletin. The classification shows the number of pages of these publications which are devoted to each of the following general subjects: The number of pages classified is 4,185, of which 1,360, or 32.5 per

cent, falls under the head of botany, including the study of fungi and the work with weeds and seeds, while 2,825, or 65.6 per cent, falls under the head of horticulture, including the combating of insects and diseases, and 80 pages, or 1.9 per cent, falls under the head of forestry. The horticultural matter is classified under the heads of (1) combating enemies, including the treatment for insects and diseases and the use of apparatus adapted to this work; (2) methods and management, including plant propagation, greenhouse lighting, training plants in greenhouse, garden, or orchard; tillage, cover crops, rotation, thinning fruit, and the harvesting and handling of horticultural products; (3) fertilizers, including the study of soils and fertilizers for greenhouse work and the use of fertilizers in gardens and orchards where this work is done by the horticulturist, either alone or in cooperation with some other member of the station staff, and (4) variety work, including plant breeding, self-sterility, and cross pollination of varieties, and simple tests of varieties, whether in greenhouse, orchard, or garden.

Reports on work with varieties occupy 23.2 per cent; on fertilizers, 6.4 per cent; on methods and management, 18.2 per cent, and on combating enemies, 17.5 per cent of the total number of pages examined.

Not all of the work here classified under horticulture has been done by horticulturists. Botanists have done some work with agricultural plants in plant breeding or plant introduction and a considerable portion of the work with pollination; chemists have cooperated with horticulturists in some of the work with fertilizers, while horticulturists, botanists, and entomologists have experimented with the treatment against insects and diseases. This state of affairs suggests the question, What is the function of the horticulturist in the agricultural experiment station? Horticulture is an art, but it is also a science. There is a science of horticulture, just as there is a science of agriculture. No part of it can be called pure science. It deals not with causes or laws or forces, apart from any application of them, but with the facts or phenomena of horticultural import as produced or accounted for by causes, laws, or forces. In the course of his experience with plants and plant products the horticulturist sees certain results, and he may seek to know how or why they were produced; or he desires certain results with plants or plant products, and he may seek to know how to produce them; he may see other results which he would avoid, and desires to know how to avoid them. His inquiries may lead him into the field of botany or of chemistry or of physics or some other science, but only that the knowledge gained from these sciences may be applied to some horticultural problem.

For various reasons station horticulturists do not always select for investigation the lines of work which seem to them really most valuable, nor do they always give first place to the questions which seem to them most important. It is often impossible to command the time or the funds or to secure the necessary equipment for such investigations. On this account a report of the investigational work which station horticulturists have published does not give so true an indication of their conception of the function of the station horticulturist as it would could they always do the work which seems to them most important. Forty-four horticulturists replied to the query as to what lines of investigation they consider to be of most importance. Twenty-four would test horticultural varieties, and fourteen of these rank this as work of prime importance. Twenty-three would follow plant breeding and plant introduction, including the improvement of native fruits, and fourteen of these rank this as work of prime importance. Three would investigate self-sterility and cross pollination as related to productiveness. Twenty-four would investigate questions on methods and management in pomology, and nine of these give this work first rank. Fifteen would work on similar questions in olericulture, and two give this work first rank. Five would work on similar questions in floriculture and landscape gardening. Fertilizer problems in pomology would be studied by seven, in olericulture by five, and in floriculture by one. Problems in greenhouse work would be studied by eight, in irrigation by seven, and in combating insect enemies and plant diseases by fourteen, three of whom rank this as work of prime importance. Only one would undertake work in systematic botany, while seventeen would investigate questions in plant physiology, six of whom rank this as work of prime importance. Three would work on forestry problems. One has for four years given considerable attention to work with seeds.

It is especially interesting to note that in these estimates plant breeding takes practically equal rank with variety testing. The latter has unquestionably in the past received more attention than it deserves, while the rising tide of interest in plant breeding promises to soon lift this subject into greater prominence than it merits. There is undoubtedly greater need for variety testing in some sections than in others. In those States where horticultural interests have become well established it is vastly more important to understand more fully the scientific basis of horticultural opera-

tions than it is to increase the list of horticultural varieties which are adapted to those sections. In other parts of the country where horticultural industries are comparatively new and untried the finding of varieties best adapted to the local conditions is relatively of greater importance than it is where horticultural interests are already well developed.

It is significant testimony to the relative importance of variety testing as compared with other lines of horticultural inquiry when one who has long been engaged in this work deliberately abandons much of it for what he considers work of more permanent value. Such is the attitude toward this work of Prof. E. S. Goff. He has been identified with variety testing at the experiment stations for many years. He was engaged in this work under Dr. Sturtevant at the station at Geneva, N. Y., for several years before the Hatch Act was passed. In a recent communication he says: "It is our plan to confine our work in the future very largely to the investigation of questions that increase our knowledge of plant nutrition and development rather than the testing of nurserymen's and seedmen's varieties. The latter work has been wholly abandoned by us except in the tree fruits."

That other horticulturists recognize the need of such work as that which Professor Goff considers most important is shown by the above classification of the reports from horticulturists in which problems in plant physiology rank next in number to questions in methods and management. Under the latter heading are grouped a great variety of topics in which the application of chemistry or physics is often more prominent than botanical problems. Taking all of the reports into consideration it is evident that in the minds of horticulturists the science of horticulture is more intimately associated with the science of botany than with any other one science. In class room and laboratory instruction the botanist usually directs his work along lines quite distinct from those which the horticulturist follows; but in research work the station botanist often enters the field of horticulture. What is the evidence of the botanists on this point? Replies from 26 of the station botanists were received. Of these 6 have undertaken plant breeding with agricultural plants, 2 are investigating the use of fertilizers in growing certain vegetables, and 11 the treatment of plant diseases; 16 are working on the study of plant diseases, 9 on systematic botany, 4 on physiological botany, 6 on local floras and plant distribution, and several on questions like testing grasses, which are of especial interest to the agriculturist.

It is evident that the function of the station horticulturist is not altogether and always sharply separated from that of the station botanist. Doubtless one great reason why the lines are not more strictly drawn between botanical and horticultural investigation is that in so many cases the horticulturist is himself the botanist. One Western botanist naively remarks that he fears that in most Western stations the function is determined by the time at command after college duties are performed rather than by any philosophical consideration of the subject.

In studies concerning tillage, fertilizers, soil physics, and other subjects which might be named the horticulturist is confronted with questions similar to some of those with which the agriculturist or the physicist or the chemist deals. Along with the botanist he works on questions in plant physiology. In the treatment of injurious insects and plant diseases, as already mentioned, botanists and entomologists are his coworkers. It does not seem desirable to attempt to set up unchangeable boundaries between the fields of horticultural investigation and those of the other sciences which have been referred to. The following communication from Prof. R. A. Emerson bearing on this subject is worthy of consideration. He says:

"I see no logical reason why the horticulturist should not, if he desires, do work along the same lines as that done by many entomologists. The same will apply to the work done by many botanists or vegetable pathologists. The vegetable pathologist and entomologist, it is to be presumed, are better able to study the life histories, habits, structure, etc., of fungus diseases and insects than is the horticulturist. When it comes to remedial measures, however, I believe the training of the horticulturist will enable him to devise more practical schemes and to come into closer touch with practical horticulturists than will the training of botanists and entomologists. In the same way I can see no reason why the horticulturist should not, if he desires, study questions of soil and their treatment. He is certainly just as much interested in this work as is the agriculturist who deals with field crops. The agriculturist, likewise, might very logically make a study of plant breeding, since he is interested in the improvement of the crops he deals with. But the training of an agriculturist is usually, I think, more along the lines of chemistry and physics, while the training of the horticulturist is largely along biological lines. It therefore seems wise to me to leave to the agriculturist questions of the chemistry and physics of soils, of course reserving the right to study questions of cultivation of special importance to the care of horticultural crops. For the same reason I believe that the

agriculturist should leave to the horticulturist the general questions regarding plant breeding, though, of course, there is no reason why the agriculturist should not study some special questions relative to the improvement of his own crops."

Horticulturists, I am sure, are glad to receive and so far as possible cooperate with the workers from other sciences who may desire to investigate problems concerning horticulture. The fields to be explored are large; the questions to be answered are numerous. There is plenty of room for all workers who wish to extend our knowledge on horticultural subjects. But when the affairs of the experiment station are so directed that the station horticulturist is practically excluded from investigational work it is but natural to feel that the station funds are not being used as they should be. One station horticulturist reports: "The horticulturist of this station is limited to $500 per annum for all expenses, including labor, feeding of teams, and in fact everything except the salaries of himself and his assistant. When all purchases of whatever sort are to come out of this sum and the grounds are to be kept in order and land cultivated to produce feed for teams used in the work there is little left for investigation work of any kind." If we have a correct idea of the existing conditions at other stations this situation in its essential features is not entirely unique. Under such circumstances station workers can not be expected to accomplish to any considerable extent the evident purpose for which the experiment stations were established as it is stated in the Hatch Act. It seems that in such cases it would be better to reduce the number of station workers in order to give those who remain better equipment.

S. A. Beach, *Chairman.*

The report of the Section on Entomology was read by H. Garman, of Kentucky, as follows:

Report of Section on Entomology.

Thirty-nine replies were received from agricultural colleges and experiment stations in response to inquiries addressed to each asking for information concerning the present condition of its entomological work. Seven of those from which no replies were received appear by the most recent organization lists to have no entomologist, leaving five institutions known to have such workers who have not reported. These latter are Minnesota, Missouri, Tennessee, Virginia, and West Virginia. Some data concerning these have been gathered in other ways, so that it is possible to state the facts concerning entomology in the colleges and stations with some completeness. No reference is here made to schools for negroes, which appear not to have specialized in nature study to the extent of making entomology a separate branch of instruction.

It appears from the information gathered that about 90 per cent of the colleges and stations now have entomologists connected with them; that about 45 per cent of the stations employ men who do no other work, while about 23½ per cent of the colleges employ men who teach only this subject. This difference between college and station is to be explained as an outcome of the restricted field occupied by the station, which allows it to get close to its work more promptly. There are some recent indications that this specialization in both college and station is to continue, shown in the appointment of an entomologist for the Delaware Station, where formerly the work was done by the horticulturist; in the appointment of one for the South Carolina Station and College, where until recently the entomology has been in charge of an assistant horticulturist and entomologist; in the Arkansas Station, where the subject has been placed in the hands of a horticulturist and entomologist; in Texas, where liberal appropriations have been provided by the State to establish an entomologist at the college and station; and in the University of Illinois and the Massachusetts Agricultural College, each of which has now a chair of entomology filled by men who devote themselves to instruction in this line.

ENTOMOLOGY IN THE SOUTHERN STATES.

It is especially gratifying to note that some of these advances are made in Southern States, where the prevalence of text-book instruction in preparatory schools and the dominance of ideals of education which go hand in hand with this mode of teaching have long retarded nature study. Attention is directed to the fact that the people themselves of these States are pushing the interests of subjects related to agriculture by making special appropriations and by enacting inspection laws. Virginia, North Carolina, South Carolina, Alabama, Louisiana, Texas, and Kentucky have each enacted a law in the interest of entomological work. On the other hand, in the Southern colleges it seems to me that entomology is not receiving the attention it deserves.

In one of them I am informed that entomology is being entirely neglected, though this same State has a law requiring the inspection of nursery stock. In another, where no entomologist is employed, the subject receives some attention at the hands of instructors whose time is largely devoted to botany. In but three of the colleges is entomology in the hands of men who do no other instruction work. With the exception of the Kentucky Agricultural and Mechanical College, none of the Southern colleges offer a special course in entomology.

In the stations the outlook in the Southern States seems particularly bright. The opportunities for original work, both economic and purely scientific, are not better anywhere else in the country. The interest in this work shown by the people is most encouraging, and has done much to keep alive the enthusiasm of the workers. One of these men writes: "Our people are fully alive to the importance of insect warfare, and I have about as much inspection work as the States where drastic legislation is on the books, and I dare say have as good, if not better, results from this healthy public sentiment as any legislation can possibly cultivate."

NURSERY INSPECTION IN RELATION TO STATION WORK IN ENTOMOLOGY.

A sudden demand on the part of fruit growers and nurserymen for inspection of nursery stock has thrown work of this character on many of the stations, and seems likely to reach others not yet occupied with inspection except as it is demanded and paid for by individuals who wish to ship trees into States whose laws require inspection certificates. Most of the station entomologists not yet required by law to do this work report frequent calls for such inspection, so that the question as to what is the best provision to make for the work has lately become an important one. Whether it is best to leave inspection entirely in the hands of the entomologist, as in Kentucky, Indiana, and Illinois; in the hands of a board composed of several station men, as in Maryland; in the hands of the State commissioner of agriculture and entirely independent of station work, as in New York; or under a State board, with the station entomologist as chief inspector, as in Ohio, are questions which some of the stations may soon be called upon to decide. It is desirable that the laws be uniform in character, and to this end some useful work might be done jointly by the horticultural, botanical, and entomological sections of this Association in the way of framing a model law, meeting as nearly as possible all the requirements.

As to the value of inspection there can no longer be any question. Criticisms of inspection and inspection certificates made before the subject had been studied and tested in a practical way have nearly all fallen to the ground. In my judgment inspection is one of the most effective means of lessening the injuries of fruit insects that has yet been tried. The fact that the premises of a nurseryman are to be visited by an inspector leads to increased care on the part of the grower, who realizes perhaps more keenly than anyone else the injury that would come to his business if San José scale or other destructive pests were discovered and the fact made known to the public. When we began inspecting we were told that it was utterly impossible to examine all the trees of a nursery so minutely as to discover scale insects should these be scattered and very few in number, which was partly true. But in practice most of us found that we had a hundred or more eyes to assist us; first, those of the nurserymen, and then those of buyers, who take special delight in catching either nurseryman or inspector. The possibility of having sent him twigs infested with San José scale taken from trees he has inspected and pronounced free, sharpens the perceptions of the inspector not a little. Fourteen of the station men reporting to me have more or less inspection work to do. Several others express their interest in the subject and hope that laws will soon be enacted in their respective States.

EQUIPMENT.

At the outset the most serious hindrances to work in entomology were lack of laboratories, literature, and conveniences for rearing insects. Laboratories have in some sort been supplied. Sufficient special literature is still lacking in some of the institutions, and while all have conveniences for rearing insects in boxes not all have quarters in hothouses where food plants can be grown and thus something approaching out-of-door conditions be supplied. Where insects are difficult ones to rear and the number of annual broods is the question to be settled, this is often an important matter. Several of the entomologists report that while they have no separate insectary they are allowed ample room in conservatories or hothouses established for other work. The advantages of a separate house where everything—heat, light, fumigation, etc.—can be controlled according to the requirements of the entomologist, and where he can keep things under lock and key, are such that an independent

establishment seems an essential part of the entomologist's equipment for his work. The form of insectary most in use at the colleges and stations is that first planned by Prof. J. H. Comstock for the Cornell Station, and consisting of a head house and an appended glass house of two sections—one heated, the other not. In the main it is well suited to its purpose, yet it may be suggested that consultation among entomologists who have had experience with such buildings would possibly result in improvements on this plan that would help those who may build in the future. Several of the entomologists report insectaries in prospect.

At present the Colorado State College has an insectary constructed for work with bees only. The University of Illinois, the Kentucky State College Experiment Station, the Maine State College, the Massachusetts Agricultural College, the New Hampshire College, the Cornell University Station, the New York Station at Geneva, the Ohio Station, and the Oregon College and Station are provided with insectaries for general work in entomology.

ASSISTANCE.

Where the entomologist is burdened with the inspection of nursery stock, it is imperative that he have good assistants, such as can be left in charge of one part of the work when his attention is required in another direction. While the use of student assistance has its advantages to the college in giving training, such help is often very detrimental to investigation, where a mistake made by a boy who is being pushed by four or five studies may result in the loss of a whole season's work relating to a life history. There are probably few of us who have not at some time been compelled to put aside work because of some oversight or mistake made by assistants of this sort. There is always some work that can be done by this kind of help, but a dependable man whose time is at the command of the entomologist is a necessity where the work has developed as it should. Nearly half of the men reporting to me have regular assistants, most of them but one, who receive salaries of from $40 to $1,000 per year. At the Massachusetts Agricultural College, Cornell University, and the University of Illinois entomological work is well provided for in the matter of assistance. There are but few entomologists at other institutions that could not make profitable use of more trained assistance than they now have.

ENTOMOLOGICAL PUBLICATIONS.

The published work of entomologists of the colleges and stations is accessible to everybody and speaks for itself. As a whole, last year's product seems to me better than that of any previous year. If I should venture any criticism on it, it would be that in the desire to do work that has never been touched before we sometimes neglect life histories of common species that would be of more immediate value, from an economic standpoint, and of scarcely less purely scientific value, than work relating to little known injurious species. The life history of an insect in Massachusetts may be very different from that of the same insect in Florida, Mississippi, or Texas, and such differences may involve different treatment.

DIFFICULTIES.

Lack of funds is given by one of my correspondents in explanation of absence of good facilities for entomological work. Another complains that the funds are being appropriated by another department. A third tells of an excessive amount of instruction work on his hands, so that he can not get time for investigation. There may be good reasons for all these failures to provide equipment and opportunity, but in the interest of good men who may be struggling against difficulties not of their own making it may be suggested that it is wholly within the limits of possibility that capable men are sometimes made to fail by the indifference, hostility, or absolute incompetence of men placed in authority over them.

NOTABLE IMPROVEMENTS.

Mention should be made of several institutions for creditable improvements in their entomological departments during the past year. The Delaware College has greatly strengthened her entomological department by the purchase of special literature and by building up a collection. At the University of Idaho new quarters and other facilities have been added during the year, more advance having been made, according to the entomologist, than in all previous years of his incumbency. At the Kentucky College a special course in entomology is now offered and funds provided for a complete new equipment of microscopes. New quarters for the entomologist have

been provided by the Louisiana Station. The Ohio State University, at Columbus, offers a fellowship in entomology for graduate students, and a special summer course at its Lake Laboratory, at Sandusky. In South Carolina and Texas entomology has been placed on its feet by liberal appropriations of money and the appointment of good men.

But the progress made by several institutions deserves special mention, because it marks an epoch in the history of entomological instruction in the United States. Massachusetts has sometimes been charged with being unprogressive, but in the direction of nature study has always been in the front rank, and lately shows a disposition to lead the States. The entomological department of her State College has long been known to entomologists as one of the best in the country. A few years ago an entomological laboratory costing $3,000 was added to her insectary, and this year she steps forward again, offering a graduate course in entomology leading to the degree of doctor of philosophy. If there is any similar opportunity offered to entomologists elsewhere, I have not heard of it. Already with an accomplished entomologist in charge of biological work, another is now added to her force, who occupies a full professorship in entomology. As showing the nature of the new course the following is quoted from the college catalogue for 1900:

"GRADUATE ENTOMOLOGY.

"This department is now prepared for and is receiving graduates from this and other colleges who wish to continue the study of entomology beyond what they were able to do in their undergraduate course. These advanced studies will fit them for positions in the experiment stations or as State entomologists, and also give them most excellent training as teachers in our high schools and colleges.

"A three years' course, leading to the degree of doctor of philosophy, is in active operation, three subjects—botany, chemistry, and entomology, arranged as a major and two minors—being required. In those cases where entomology is chosen as the major subject the course consists of lectures and laboratory work, some of the topics treated being the following:

"General morphology of insects: Embryology; life history and transformations; histology; phylogeny and relation to other arthropods; hermaphroditism; hybrids; parthenogenesis; pædogenesis, and heterogamy; colors (chemistry of colors in insects); luminosity; deformities of insects; variation; duration of life.

"Ecology of insects: Dimorphism; polymorphism; mimicry; warning coloration; insect architecture; fertilization of plants through the agency of insects; instincts of insects; insect products of value to man; geographical distribution in the different faunal regions; methods of distribution; insect migrations; geological history of insects; insects as disseminators of disease; enemies of insects, vegetable and animal, including parasitism.

"Economic entomology: General principles; insecticides; apparatus; special cases (borers, etc.); photography of insects and their work; methods of drawing for illustrations; field work on insects; insect legislation.

"Systematic entomology: History of entomology, including classifications and the principles of classification; laws governing nomenclature; literature, how to find and use it; indexing literature; number of insects in collections and in existence (estimated); lives of prominent entomologists; methods of collecting, preparing, preserving, and shipping insects; important collections of insects.

"In connection with these topics corresponding laboratory work is given as far as possible, and, in addition, investigations on subjects not previously studied are made and the results published in the form of graduation theses."

An experiment being tried at the New York Station at Geneva deserves mention in this connection. A limited number of graduate students from science courses are admitted to its laboratories, where they are given opportunities, under the direction of heads of departments, to engage in research work. The experiment is interesting as pointing out a way by which the stations can be utilized for training investigators without detriment to the work for which they were established.

In Illinois, nature study in the public schools has long been in about the same condition as in Massachusetts. An interest in entomology has been developed there by the work of her State entomologists, who have published annual or biennial reports on the injurious insects of Illinois, beginning with 1862. One of these entomologists has been stationed at the university since 1884, and has had charge of all the entomological work of the university. Without ostentation this has been steadily pushed forward until to-day, with the extensive library and collections of the Illinois State Laboratory of Natural History at its command, an effective biological laboratory, with steam launch and other modern equipment, it seems in some directions

the best equipped of any entomological department in the country. The university received some years ago the Le Baron collection of insects from the Le Baron heirs. This year it has received the Bolter collection, containing 15,000 species, represented by 70,000 specimens, and besides 30,000 duplicates. Instruction work at this university has also received recognition in the appointment of an instructor, who will give his entire time to teaching the subject.

In California the general interest in fruit growing has developed a corresponding interest in economic entomology, shown in legislation with reference to fruit pests, and especially of late by the large number of students doing entomological work at the State University at Berkeley. During the past year, I am informed, the number who received instruction in entomology was 250, probably more than in any other school in the country. No special course is provided yet, but entomology may be made a major subject in courses for the degree of bachelor of science.

Progress of the kind mentioned is the outcome in great part of the esteem in which entomology is held by those engaged in agricultural pursuits, but it is rapidly being accepted by teachers in public schools as one of the most convenient means of putting the truths of biology before pupils and of giving training in observation. With botany, it seems to me destined to become the teacher's most effective vehicle for conveying this information and training.

H. Garman, *Chairman.*

C. S. Murkland, of New Hampshire, read the following report from the Section on Mechanic Arts:

Report of Section on Mechanic Arts.

When Congress passed the famous act whose phrases have become familiar by frequent repetition, it was hardly possible to forecast either the growth which the State institutions would disclose in the course of a generation, or the peculiar tendencies which a generation would develop. But in the retrospect it appears natural enough, inevitable perhaps, that these institutions should become in themselves so considerable, should modify so largely the common methods of education, and yet should yield in matters fundamental to the pressure of circumstances beyond their immediate control. It is an open secret that the influence which was finally decisive in determining the attitude of Congress was the influence of the agricultural interests. Agriculturists were organized. They were therefore a force to be reckoned with, and not to be rashly ignored. They held the fortunes of the bill in their power. They elected to favor it because they anticipated the return of various benefits, among which was the elevation of the condition of the farmer, and the reestablishment of the favorite calling in its old and proper dignity. They looked for the rapid development of agricultural education as a means to that end, in these colleges and elsewhere, by means of the college influence. How far these early anticipations have been realized need not be indicated; it is evident enough. And I recall these familiar facts for their bearing upon something else, namely, the unanticipated predominance which studies not related to agriculture were to assume in many of these institutions. Statistics are not easily gathered, nor of great value when obtained unless they are unusually comprehensive in their scope. The numbers of students who have pursued agricultural courses give no measure of the influence of the colleges upon agricultural interests. We might gain some light if we could follow these students out into the world, ascertaining and formulating the activities to whose service they devote their education. But aside from such exact research, the general truth is obvious enough—that upon the whole the studies grouped under the head of mechanic arts have had more extended development, have enjoyed better educational facilities, than the studies designated agricultural.

That this resulted from any definite intention to develop one side of the colleges rather than the other no one for a moment supposes. That the result was in some measure affected by the relatively slight regard in which agriculture was held, can hardly be questioned. But this factor was popular, rather than institutional. Nothing is more sensitive to popular feeling than a college. It has always to keep an eye open to its actual constituency, and the possibility of enlarging the same. While it may oppose and denounce crying evils, and attempt to explode popular fallacies, it must afford the kind of education the people demand. So long as the colleges formed a kind of educational combination, each turning out the same product under an unwritten agreement of uniformity, they could exercise some control over the popular demand. Put they inevitably tore away the foundations of the system they maintained. The development of education by the colleges made it possible for other influences to demand vital changes in method and outlook of the colleges. If

there is one characteristic common to them all to-day, it is that of uncertainty. No man knows, certainly no college official knows, just where to place the emphasis in order to anticipate the educational demands of the immediate future. And between the vacant folly of the attempt to anticipate every demand and the serene stubbornness of the attempt to fit all students to the educational bed of Procrustes, the colleges run the whole chromatic scale. Even the honored time limit is assailed, and one does not know whether the college course of to-morrow shall continue through four years, or three, or five. So indeterminate are the educational factors.

In the midst of all this uncertainty, part of which must be charged to the land-grant college, it is not to be greatly wondered at that the studies encircled in the convenient and comprehensive mechanic arts should have assumed a relative significance in no way hinted at in the early prognostications. The successive steps in the process are not hard to retrace, although they were hard to foresee. That story has been told and retold; it is not worth while to ravel the web for the sake of weaving it again. The fact is enough, and it is evident enough. But one train of sequences I would like to follow a little way—namely, the scholastic.

The mechanic arts (I use the term as a comprehensive synonym for the studies it includes), had this advantage—a convenient point of contact with the schools and with the scholastic methods. That common ground was mathematics. The mechanic arts could begin where the common school left off, and could therefore appeal to the high-school graduate, and offer him at once some new labor worthy of his excessively conscious powers. And I suppose that mathematics remains to this day the actual defense of our claim to the college standing if not to the college title. We raise our standard of requirements for admission by adding solid geometry and trigonometry, with various accessories of elementary science. The mathematics is our object.

But this convenient point of contact with the schools has led us into difficulties. It tempted us to ignore the things that went with mathematics in the common high-school schedule. The high school or academy must distribute its mathematics over three or four years, and the student must have something else to do also during that time. Something else, of course, but what? I venture to say that the question embodies our most perplexing educational problem.

Two forces operate to increase the confusion. The colleges which are not of the commonwealth of Israel have been able and perfectly willing to say what should constitute, with mathematics, the staple article of high-school education; and they said Latin and Greek, first. Some of them rested their case there. Others, more fearless perhaps, said Latin anyway and Greek if you don't object. Others, bolder still, or the same ones grown bolder, said Latin and Greek, or Latin and French, or Latin and German, or Greek and German, or Greek and French—something anyway; two somethings, and two linguistic somethings. But why this last conditioning when so broad a liberty is conceded? Well, chiefly, beyond doubt, because the modern languages may borrow the long-tried methods of the ancient, and because the ancient languages, like mathematics, have the heritage of centuries of practice in method. Also because it is a wearing process to knock out of the college freshman the pseudo science that was packed into the high-school senior.

Well, in the meantime, engineers made engineering more exacting, and engineering retaliated by demanding better engineers, for mechanic arts had already expanded into engineering. How get better engineers? Four years are but four years, and even a land-grant college can not make bricks without straw. More mathematics to start with; given mathematics enough and you may have your engineers in two years—I had almost said two weeks. But more mathematics must mean also a certain maturity of mind—and what of the other things that may contribute thereto? More Latin and French—or what? The mechanical department is face to face with the necessity for a more complete understanding with the schools. For lack of it we are turning out what? Engineers—in the full sense of that exacting title? Hardly. My eye fell upon a rather satirical poem in our students' monthly, evidently a student's poem. It closed something like this: "So come to Durham College and learn to be a boss"—and I haven't recovered from the shock of it yet. In fact, our course in mechanical engineering, and in electrical engineering, and in this and that, closely parallels your course in that and the other. The student has by nature a fine eye for a shot when he is gunning for the institution. Now, did he hit the mark—he who sped that shot—"and learn to be a boss?" For myself, I have a lurking fear that the shot did not go wide—whether the mark was the college of New Hampshire or that other State—not yours, of course.

All this may be summed up in the words of one of the prophetic spirits, who might have been speaking to our country or to our colleges when he said, "Thy rowers have brought thee into deep waters." Commerce is inspiring and profitable, but you

must plow the deep waters for it, in difficulty and danger. And commercialism multiplies the danger and hardship to the point of fatality. Engineering is fascinating and lucrative, and it makes us run and reach, in fair wind and foul, with tides of every sort and measure. And *engineeringism*—it's a barbarous word, I know; it ought to be—is the invitation to disaster. So, for that matter, is agriculturism, or any other excess of industrialism. It is not altogether unfortunate that we have felt the drag of the high-school inertia. Before we utterly condemn it let us be sure it is so utterly at fault. I believe in the mechanic arts as I believe in the art of agriculture; we must cultivate them to the last refinement; we must have our common schools properly responsive to the demands imposed upon them by the necessity laid upon us. But, after all, men and women were very happy before they had the telephone, and light and heat by wire. We could not dispense with our products of the mechanic arts; still less can we dispense with the static elements upon which, after all, human happiness and use depend. I rejoice in the humaneness of President Stubbs's address; in the pertinence of its reiterated central truth. The use of the mechanic arts is in the art of doing well. It is at our peril that we trifle away with agriculture or the mechanic arts, the formative period of student life. When we essay the correction of the public school we shall be fortunate if we do not overshoot the mark and make our divine practicality "procuress to the lords of hell." Fathers and brethren—there is a genuine lovableness in the old churchly formula—fathers and brethren, we have something to look to besides farming and engineering. It is unpardonable in us to mistake the farmer of the broadest unencumbered acres or the expert with the most awe-inspiring salary for the most successful man. That was grim humor of Carlyle's, "there are thirty million people in England, mostly fools." Folly with Carlyle was synonymous with that unethical view of life which tempts us through our very practicality. Mechanic arts by all means; engineering pushed on and on till it weeps, like Alexander, for more worlds to conquer. But no art is true to itself till it glories in its divine calling. And the real world for our conquest is the world of the unseen and eternal.

C. S. Murkland, *Chairman.*

On motion of H. P. Armsby, of Pennsylvania, the by-laws providing for the committee on nomenclature were repealed.

The report of the committee on collective station exhibits at the Paris Exposition was submitted by H. P. Armsby, of Pennsylvania.

Report of Committee on Collective Station Exhibit at the Paris Exposition.

In making this, its final report, your committee feels it desirable, even at the risk of repeating statements made at length in previous reports, to recall to mind as briefly as may be the nature of the commission intrusted to it and the circumstances surrounding its execution.

Having in mind, doubtless, the collective exhibit made by the colleges and stations at the World's Columbian Exposition at Chicago in 1893, the convention of 1897 instructed us, in substance, to endeavor to secure the cooperation of the United States Department of Agriculture upon a basis similar to that of 1893, and, if that cooperation could be secured, to proceed with the preparation of the exhibit. It has already been stated in previous reports, but may properly be emphasized again at this time, that your committee met with a most cordial reception from the Secretary of Agriculture and has enjoyed throughout its labors the active and efficient cooperation of the Department through the Office of Experiment Stations. With this essential secured, your committee proceeded to carry out the task committed to it as best it might.

The spirit if not the letter of our instructions contemplated a collective exhibit, illustrating the aims, methods, and results of the experiment station enterprise in the United States as a whole rather than the work of individual stations. The necessary limitations imposed by distance and by the restricted space available served to emphasize the necessity for concentration, and it has been the aim of your committee to select for graphic illustration such salient features of station work in various departments as lent themselves most readily to this treatment. So far as possible it has been our aim to exhibit objects showing either methods or results of investigation, while in some cases models were employed for the same purpose. Eighteen stations contributed to this portion of the exhibit, which also included a showing of the irrigation and nutrition investigations in charge of the Office of Experiment Stations, an exhibit by the Division of Soils of the Department of Agriculture, and a special exhibit by the Sugar Planters' Experiment Station of Hawaii.

The objects exhibited were.

Soil apparatus.—This consisted of a number of electric devices for determining the salt content, temperature, and moisture of soils, with samples illustrative of typical agricultural soils of the United States. Contributed by the Division of Soils of the U. S. Department of Agriculture.

Soil elutriator.—This apparatus was designed by E. W. Hilgard for the mechanical analysis of soils. Contributed by the California Experiment Station.

California agricultural soils.—Samples of six typical agricultural soils of the State were shown, together with the results of analyses by the elutriator method of a portion of each soil. Contributed by the California Experiment Station.

Soil map of California.—This colored map showed the distribution of soil areas throughout the State. Contributed by the California Experiment Station.

Gas desiccator.—A form of apparatus designed by Prof. S. W. Johnson for use in drying gases in various experiments. Contributed by the Connecticut State Experiment Station.

Auxanometer.—This instrument was designed by Prof. L. C. Corbett and is used for determining and automatically registering the rate of plant growth. Contributed by the West Virginia Experiment Station.

Transpiration apparatus.—Designed by Prof. L. C. Corbett to be used in determining the rate of transpiration of plants. Contributed by the West Virginia Experiment Station.

Centrifuge.—Designed by Dr. J. C. Arthur to be used in experiments in vegetable physiology for ascertaining the effect of gravity and centrifugal force on germinating seeds. Contributed by the Indiana Experiment Station.

Vegetable proteids.—A collection of chemically pure proteids separated from the seeds of various plants by Dr. T. B. Osborne. Contributed by the Connecticut State Experiment Station.

Root cages.—These were designed to show the distribution of the roots of plants when grown under normal conditions. The specimens shown displayed the root systems of maize, wheat, flax, and brome grass. Contributed by the North Dakota Experiment Station.

Distribution of roots in soils.—Illustrations showing the distribution in the soil of the roots of maize, clover, apple trees, raspberries, etc. Contributed by the Wisconsin Experiment Station.

Crosses of cotton.—Exhibit of 72 selected and crossbred varieties of cotton. Contributed by the Alabama College Experiment Station.

Saltbush.—A specimen of forage plant which has proved valuable for growing on strongly alkaline soils. Contributed by the California Experiment Station.

Models of fruits and vegetables.—Models of sweet potatoes, peppers, apples, and plums, illustrating the varietal differences of these fruits and vegetables. Contributed by the Iowa and Minnesota Experiment Stations.

Grape models.—Designed to show the effect of pollination upon self-sterile and self-fertile varieties of grapes. Contributed by the New York State Experiment Station.

Olive exhibit.—Fifty samples of olive oils showing the effect of different methods of manufacture, and also more than 250 samples of olive pits used in the classification of varieties of olives. Contributed by the California Experiment Station.

Winter protection of peach trees.—Charts and photographs showing the results of experiments on whitening trees in retarding their development in the spring. By means of this protection the trees were retarded sufficiently to escape the injurious effect of late spring frosts. Contributed by the Missouri Experiment Station.

Weed seeds.—Specimens of the seeds of 100 of the more common weeds of the United States, arranged by Dr. B. D. Halsted. Contributed by the New Jersey Experiment Stations.

Leaf-spot diseases.—Mounted specimens of 18 of the more common leaf-spot diseases. These specimens were mounted in glycerin jelly between plates of glass. Contributed by the Massachusetts Hatch Experiment Station.

Insect cabinet.—A form of insect cabinet designed by Prof. C. W. Woodworth. Contributed by the California Experiment Station.

Respiration and bomb calorimeters.—The respiration calorimeter is designed to determine the metabolism of matter and energy in the human body, and the bomb calorimeter for determining the food value of foods, feeding stuffs, etc. Contributed by the Connecticut Storrs Experiment Station.

Animal and vegetable fats.—Samples of a number of animal and vegetable fats, together with data relative to their physical and chemical properties. Contributed by the Missouri Experiment Station.

Meat models.—Ten models and eight photographs showing the effect of rations on the production of lean and fat meat, as shown by experiments conducted at the Kan-

sas, Iowa, Wisconsin, and New York Cornell Experiment Stations. Contributed by the committee on the collective exhibit.

Sheep crossing.—Shows the effect of crossing different races of sheep on wool production, as illustrated by photographs of the animals and specimens of the wool. Contributed by the Missouri Experiment Station.

Egg production.—Shows the effect of age of hens on egg production. Contributed by the Utah Experiment Station.

Columbian dairy test records.—A set of sheets showing the records for a single day of the different breeds of cattle tested at the Columbian Exposition, 1893. Contributed by the committee conducting the test.

Dairy bacteria.—Cultures of bacteria isolated from various dairy products prepared by Dr. H. W. Conn. Contributed by the Connecticut Storrs Experiment Station.

Overflow pipette and milk-sampling tube.—Invented by Dr. M. A. Scovell. Contributed by the Kentucky Experiment Station.

Milk-testing apparatus.—This exhibit consisted of the original Babcock testing machine designed by Dr. S. M. Babcock in 1888, Facile and Russian Babcock machines with accessories, milk glassware, and minor dairy apparatus. Contributed by the Wisconsin Experiment Station.

Pressure apparatus.—Apparatus used in experiments to test the effect of pressure on the preservation of milk. Contributed by the West Virginia Experiment Station.

Cheese models.—Models designed to show the size of cheese made from equal quantities of milk, but of different fat content. Contributed by the New York State Experiment Station.

Wine cooler.—Designed for the rapid cooling of wines in the process of manufacture. Model contributed by the California Experiment Station.

Irrigation apparatus.—Contributed by the Office of Experiment Stations, Irrigation Investigations. This exhibit consisted of water registers used in measuring the amount of water flowing through streams, flumes, and ditches; a current meter, used in measuring the rate of water flow, and a hydrophore, used in determining the amount of silt carried by water, all designed by Prof. Elwood Mead; three specimens of sheet-steel pipette, extensively used in irrigation over rough regions; a sample of wooden pipette used for the same purpose; models of a Cippoletti weir, a measuring flume, and of a truss and flume across a canyon; also a set of photographs showing irrigation structures and results of irrigation.

Round silos.—Model of a stave silo, contributed by the New York Cornell Experiment Station, and of a round silo, contributed by the Wisconsin Experiment Station.

Hawaiian exhibit.—Samples of rocks, lavas, lava products, soils, varieties of sugar cane, and agricultural products, such as coffee, rice, and sugar, prepared by Dr. Walter Maxwell. Contributed by the Hawaiian Experiment Station.

A large amount of station work, however, is necessarily incapable of representation in the concrete. This class of work was largely represented by charts and photographs, of which some hundred or more were contributed by fourteen stations, the data and designs being furnished by the stations, while the charts themselves were in most cases prepared at Washington, under the supervision of the Office of Experiment Stations, for the sake of uniformity in appearance. The following is a list of these contributions:

The specific nature of galactase as a cheese-ripening ferment. 9 charts. Contributed by the Wisconsin Experiment Station.

Structure and development of nematode worms. 5 charts. Contributed by the Massachusetts Hatch Experiment Station.

The composition and comparative value of silage. 5 charts. Contributed by the Vermont Experiment Station.

Effect of alkali on the germination of wheat. 7 charts. Contributed by the Wyoming Experiment Station.

Meteorological, mycological, and entomological investigations. 9 charts. Contributed by the Virginia Experiment Station.

Composition of grain and straw of oats and wheat at different stages of growth. 6 charts. Contributed by the Michigan Experiment Station.

Results of tobacco investigations. 10 charts. Contributed by the Virginia Experiment Station.

Average digestion coefficients of feeding stuffs. 9 charts. Contributed by the New York State Experiment Station.

Results of experiments on the maintenance of soil fertility. 5 charts. Contributed by the Ohio Experiment Station.

Investigations on the source of milk fat. 7 charts. Contributed by the New York State Experiment Station.

Experiments in cross-breeding wheat. 4 charts. Contributed by the Minnesota Experiment Station.

Classification of the races of the peach. 1 chart. Contributed by the Texas Experiment Station.

Effect of commercial fertilizers on the production of maize. 8 photographs. Contributed by the Kentucky Experiment Station.

Bromid enlargements showing divers plant diseases, exhibited in portfolios. Contributed by the New Jersey Experiment Stations.

Bromid enlargements showing the effect of lime on acid soils, exhibited in portfolios. Contributed by the Rhode Island Experiment Station.

Bromid enlargements showing the effect of crossing vegetables, exhibited in portfolios. Contributed by the New York Cornell Experiment Station.

Irrigation scenes and structures and detailed drawings of many of the more important structures, exhibited in portfolios. Contributed by the Office of Experiment Stations, Irrigation Investigations.

A third class of exhibits was intended to show something of the equipment and work of the individual stations, and consisted of portfolios containing photographs of directors and staffs, buildings, grounds, laboratories, experimental plats, apparatus, and other details of equipment. This portion of the exhibit was prepared by the Office of Experiment Stations. The same office also contributed a complete set of the publications of the office and of the individual stations throughout the United States to the number of 566 volumes. Books and monographs by authors connected with the stations were shown to the number of 138 volumes, and a card index of experiment station literature, in which the results of the investigations of the various stations are shown on 19,000 cards, as prepared by the Office of Experiment Stations; also press notices, posters, and miscellaneous publications shown in portfolios.

Finally, there was prepared by the Office of Experiment Stations, at our request, what your committee feels to be the most permanent and possibly the most valuable portion of the exhibit, viz, a history of the agricultural experiment stations of the United States, prepared by Dr. A. C. True and V. A. Clark, and published by the Department as Bulletin No. 80 of the Office of Experiment Stations. This volume, of 636 pages and 153 plates, traces the evolution of the experiment station idea in the United States, gives the history and organization of each of the experiment stations and of the Office of Experiment Stations, with a statement concerning the lines of work pursued by each. The inspection work of the stations is completely reviewed, and the Federal legislation and rulings affecting the agricultural colleges and experiment stations are brought together in a convenient form. Other appendixes are given, which include a list of all the publications of the experiment stations and of the Office of Experiment Stations, statistics of agricultural experiment stations, etc.

The frequent references in the foregoing paragraphs to the Office of Experiment Stations will, we think, amply justify our previous statement as to the aid afforded by the Department of Agriculture through that office in the preparation of the exhibit. The same is even more emphatically true as regards its installation. As the contributions to the exhibit came from a large number of individuals, widely separated in space and with little or no opportunity for consultation, the preparation of a unified and artistic exhibit could be accomplished only by means of a temporary installation in this country. Space was therefore secured in Washington, and Dr. W. H. Evans, of the Office of Experiment Stations, was detailed for this work, and in continuation of it was later sent to Paris to superintend its installation there, while Mr. J. I. Schulte, of the same office, has been in Paris throughout the Exposition, and has aided in caring for and explaining the exhibit.

It remains to speak of the relations of the United States Commission to the exhibit. As the members of the convention are doubtless aware, the relations of American exhibitors to the French authorities were entirely through this Commission, which also practically controlled the expenditure of all appropriations made by Congress. As related to agriculture, the representative of the Commission was Mr. Charles Richards Dodge, who at the same time represented the Secretary of Agriculture in the preparation of the exhibit of the "agricultural resources and capabilities of the United States," which he was directed by Congress to make. In this dual capacity, Mr. Dodge, within the limits set by the prevailingly commercial purpose of the American exhibit, accorded to our particular exhibit a hearty interest and liberal treatment as to both space and money. The exhibit was placed in group 7, agriculture, class 38, and was given about 700 square feet of space in the palace of agriculture, although unfortunately upon a balcony or gallery, requiring a climb of some feet on the part of the would-be visitor. The cost of installation, including cases, transportation, and care, was defrayed by the Commission, as was also that of the preparation of numerous charts, models, photographs, portfolios, etc.

The exhibit was formally entered in the name of the Association. Your committee has received no official notice regarding awards, but is informed that the class jury recommended that this exhibit be awarded the grand prize in group 7, class 38, and that collaborators be recognized by the award of a grand prize to Dr. A. C. True, of the Office of Experiment Stations; gold medals to Profs. E. W. Hilgard, W. O. Atwater, C. F. Vanderford, T. B. Osborne, W. H. Jordan, W. H. Evans, L. G. Carpenter, and W. A. Henry; and silver medals to Profs. Elwood Mead, Milton Whitney, C. F. Curtiss, P. H. Mell, and Paul Schweitzer. In addition to the foregoing, a gold medal was awarded to Dr. S. M. Babcock by two class juries and raised by the group jury to the grand prize, in recognition of his labors in dairy husbandry. This handsome list of awards is all the more pleasing when it is recognized that, of the 21 jurors, 14 were French, 1 American, and the others from the continent of Europe.

Your committee learns that the exhibit at Paris was especially sought out by visitors interested in such matters, and was critically examined by a number of prominent investigators in agricultural science. When the exhibit of 1900 was compared with that of 1889, most favorable comments were made and astonishment was expressed at the great development in the past eleven years. The wonderful growth of the American experiment stations was particularly dwelt upon by M. Louis Grandeau, in his address before the International Congress of Experiment Stations, in which he complimented individual stations for particular investigations and the stations as a whole for what they have done to advance the sum of agricultural knowledge.

In conclusion, your committee feels it desirable to say a word respecting the disposition to be made of the exhibit upon its return to this country. We believe it may be fairly said that it constitutes the most satisfactory illustration within relative small space of the work of the stations as a whole which is now available. It is, however, composed of a large number of individual contributions and its peculiar value would be destroyed by its dispersal. It appears to us that if this collective exhibit could be suitably installed as a permanent exhibit of the experiment stations at the national capital it would serve a most useful purpose in acquainting the public with the nature and extent of their work and would amply repay the individual stations concerned for the permanent loan of their contributions.

Following the suggestion of our first report, therefore, we recommend that the executive committee be instructed to take this matter into consideration and to endeavor to make suitable arrangements for the permanent installation and care of the exhibit at Washington.

H. P. Armsby, *Chairman.*

C. W. Dabney, of Tennessee. Mr. President, I would move that the report be received and adopted, and in doing so I would like to make a few remarks in support of the recommendations of the committee from the standpoint of a juror at the Paris Exposition.

As some of us know, we sought to have this Association of Experiment Stations especially represented upon the experiment stations jury at Paris, and while we were somewhat disappointed in the outcome of our efforts in this direction I was appointed on the jury of agriculture to look after the interests of the station exhibits. I did the best I could, though I regret very much we did not have a station man upon that jury. I was the one American on the jury referred to. In regard to the report, I wish to say, first of all, that the exhibit of the stations attracted a great deal of attention and was very highly spoken of by all the members of the jury and many scientific men. It was a matter of very great regret to the jury, and to the scientific men present there in general, that our colleges were not represented at the same time. There was no exhibit from the agricultural and mechanical colleges of our country as such. At the San Francisco convention, I believe, it was resolved not to undertake that exhibit. I want to say here that I think that was a mistake. I think we should have been represented at Paris by all means. Hundreds of gentlemen came to me as the juror representing those interests and asked me where our college exhibits were. They came from all over Europe. They knew of our work and had seen our publications, and they came to me and said, "Why are your great agricultural colleges not represented?" The agricultural colleges of other nations were there, and these men came to Paris expecting to see ours. It was our fault. I think we should not allow this to happen again. I know that we had very little

encouragement to make that exhibit, and it was not altogether our fault that we failed to take advantage of this great opportunity which was open to us. We should have taken an active interest to secure space enough especially in such an exposition as this so as to have secured adequate representation. It was a matter of very sincere regret to all of those interested in the scientific side of the work in this branch of the educational system of the United States that we were not properly represented. Furthermore, the policy of the Commission of the United States at Paris was to make the agricultural exhibit there entirely a commercial one. After that policy was adopted the gentlemen in charge did the very best they could to further the interests of our State exhibits, but it is well frankly to recognize the fact that the commercial spirit was rampant, and our Department of Agriculture and our experiment stations and our colleges did not receive the encouragement that I think was their due. It was the policy of our Government Commission in emphasizing the commercial side, which was to an extent responsible, and after that policy had been established they had very little means and very little room to devote to the scientific side of this subject. The exhibits from Germany and from the United States, which were side by side, differed largely, from the fact that we had no exhibits from our stations or colleges.

The exhibits from other nations were made up very largely of exhibits from stations and colleges. Our Department of Agriculture did not receive proper attention, and when our jury came to investigate the exhibits the only thing that we had to show them was the small exhibit from the Bureau of Animal Industry. The science of agriculture, or the sciences as connected with agriculture and the educational side of agriculture were of themselves very inadequately presented at the Paris Exposition. And, as I have said, it was not the result of a want of effort, but rather the result of the policy adopted by our national Commission. I am not prepared to discuss that policy, but I would urge the Association in the future to try to secure better recognition both in the amount of funds appropriated and the space allowed at these great world expositions. We are expected there, and we ought to be there.

The report was accepted and its recommendations approved.

W. A. Henry, of Wisconsin. Mr. President, apropos of this discussion, I have a resolution which I desire to offer in regard to the work published by the Department of Agriculture. I believe it is a volume of the highest utility and of the greatest importance to our work at this time, and, as in some sense expressive of our appreciation, I offer the following resolution:

Whereas the Office of Experiment Stations has prepared at great cost of labor a history and description of our experiment stations, and recognizing the great good that may follow by the publication and distribution of the second edition,

Resolved, That we extend to the Secretary of Agriculture our hearty thanks for this timely effort, and urge upon him the publication of the second edition and the judicious distribution of the same.

I truly believe, Mr. President, that the passage of that resolution would show our sense of appreciation of the great labor and high efficiency of the Office of Experiment Stations in preparing this history of the present status of our experiment stations, and I believe it would accomplish much good if our able Secretary of Agriculture can be induced to publish the second edition.

The resolution was referred to the executive committee, which later reported favorably and the resolution was adopted.

Prof. William H. Brewer, of the Sheffield Scientific School, invited the members to visit Yale University and called attention to the parts of particular interest to them.

Evening Session, Tuesday, November 13, 1900.

The convention was called to order at 7.45 p. m., President M. H. Buckham, of Vermont, in the chair.

The Chairman. The first thing this evening we will listen to the report of the bibliographer of the Association, Dr. True.

A. C. True, of the U. S. Department of Agriculture. Before presenting my report I feel sure that the Association will pardon me if I say that on behalf of the honorable Secretary of Agriculture I wish to convey to the Association his regrets that he is unable to be present at this meeting of the Association. Very urgent and important public business detains him in Washington this week, but he wished me to say that his heart was with us here, and that he hoped we would have a very successful and profitable meeting. It is of interest also on this occasion to refer to the authorized announcement that the President has expressed his desire that the present members of his Cabinet should retain their positions during the next four years. That, I trust, will insure in the Department of Agriculture a continuous policy, and I think this is very likely to be productive of important results for the interests which we have so much at heart.

I submit the following report as bibliographer:

Report of Bibliographer.

In continuing the survey of current bibliographical work relating to investigations in agriculture, your bibliographer has noted during the past year the growing interest in this matter as indicated by the increasing number and variety of bibliographies on such subjects which are appearing in print. A list of partial bibliographies which is included in this report numbers 41 titles.

The Office of Experiment Stations has continued to do considerable bibliographical work. In connection with the account of the agricultural experiment stations in the United States prepared for the Paris Exposition, a subject and author list of the publications of the stations from 1875 to 1899, inclusive, was published in Bulletin 80 of this Office. This list included 5,020 titles of station publications and 180 of publications of the Office of Experiment Stations. An index to the record in Congress of the late Senator Justin S. Morrill was compiled from the Congressional Globe and Record, with special reference to his connection with national legislation for the endowment of agricultural colleges. This index is in manuscript, and will be kept on file in this Office. Considerable progress has been made in preparing a card catalogue of foreign agricultural schools, experiment stations, and kindred institutions throughout the world. This Office has begun the annual publication of a list of foreign experiment stations in connection with the organization lists of the agricultural colleges and experiment stations in this country. The first list of foreign stations may be found in Bulletin No. 59.

The following is a list of partial bibliographies of recent works on agricultural science:

Arthur, J. C., and Stuart, William. List of the most important works on corn smut. Indiana Station Twelfth Annual Report 1899, pp. 130–135.

Ball, C. R. A partial bibliography of American seed testing and selection. Iowa State College of Agriculture Seventeenth Biennial Report 1896 and 1897, pp. 168–175.

Banks, Nathan. A list of comprehensive works on North American entomology, compiled for the use of students and other workers in entomology. U. S. Department of Agriculture, Division of Entomology Bulletin 24, n. ser., pp. 95.

Britton, W. E. Bibliography of chestnut culture. Connecticut State Station Report 1898, Pt. III, p. 288.

Carleton, Mark Alfred. Bibliography of cereal rusts. U. S. Department of Agriculture, Division of Vegetable Physiology and Pathology Bulletin 16, pp. 70–73.

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The retiring president of the Association, J. E. Stubbs, of Nevada, delivered the following address:

President's Address.

Mr. President, and Ladies and Gentlemen of the Convention: According to the requirements of the constitution of this Association, I have the honor at this time to present the president's annual address. Mindful of the strong and inspiring addresses which have been made from year to year by the successive presidents of this Association, I have ventured to choose a theme of commanding importance, and however inadequate the treatment may be, and I am sure that the treatment will be inadequate, it is one that must needs be for many years of vital interest and importance in our own field of work. When this address was prepared a few days since I was under the impression that the experiment station at New Haven was

closely connected, or officially connected, with Yale University, and that has had something to do with portions of this address. I have learned, however, that this close official relation which I was under the impression existed does not exist, but enjoying as we are the inspiration and influence of the surroundings of this university, and partaking of the courtesies of the university through the distinguished representatives of the Sheffield Scientic School, I find no reason to change any portion of this address.

What is of Most Worth in Modern Education?

By J. E. Stubbs, of Nevada.

In the month of July of last year the thirteenth annual convention of this Association assembled in the city of San Francisco. For the first time were the States of the far West honored in such a distinctive way by this Association. For the first time very many of its members traversed the domain of our common country from the historic coast of the Atlantic to the romantic shore of the Pacific. A new experience was theirs when, on the farther side of the turbid Missouri, they were carried in peace and comfort now through wide-reaching upland plain, now over mountain divide, now piercing the shadows of majestic canyons, now parting the gray ether of the desert's wide expanse, now climbing slowly to greet a new world from Sierra's lofty summit, and now at last gliding swiftly down the mountain side into the beauty of a semitropical clime and into the hospitality of a warm-hearted and cultured people.

As guests of the city of San Francisco you had an excellent opportunity to study the resources and achievements of agriculture and her allied pursuits in one of the great States of the Pacific coast. You read in the lines of one State's activities that agriculture in highly specialized forms and manufacturing industry and commerce was cooperating to justify the heroic sacrifices and the state craft that have made the Pacific coast and contiguous territory one with the thirteen original States in the common purpose to build up and to maintain forever a nation dedicated to individual freedom, opportunity, and privilege for every one of its children.

Time and place distinguish to-day the fourteenth annual convention of the Association. We meet almost at the closing hour of the nineteenth century—a century illustrious alike in men and in achievement. We meet at an illustrious seat of academic life and learning. Of Yale thus speaks one of her own sons: "She is one of those whom God has called to light and lead His people. She may with others bend a higher course to the national force which shall be greater than the world has yet seen. She is set among a people whose riches overflow, whose muscles are tense, whose heart is restless with a sense of might and responsibility, among whom the thoughtful are anxious only that a power without parallel may be applied for the blessing of our world."

And further, of her it is written what the colleges and universities of this Association may accept as a greeting and a consecration to high effort from their distinguished sister: "With her allies Yale stands up, yet prayerfully, to her godlike work. Their sympathy and cooperation she asks, and to them, as they labor to the same end, she offers her good will and sends her hopes."

It is, furthermore, the distinction of this present convention that we meet in the State which was among the very first to realize the value of the application of Liebig's researches in science to practical effort in agriculture, and the first to establish an experiment station for original research in science for the improvement and enrichment of agricultural industry. We are to share in the interest and inspiration of the celebration of the founding of the first experiment station in America twenty-five years ago, and now associated with the scientific work of similar institutions in every State and Territory of the United States.

I desire here to acknowledge the generous spirit by which you have sought to recognize the worth and high aims of the colleges and universities of the Western States by clothing one of her humblest sons with the dignity and honor that attach to the president's office of this Association. I have accepted the trust imposed and the honor conferred on me as an expression of your good will, and as showing your fraternal spirit to the smaller colleges and universities, which are striving under difficulties peculiar to the intermountain States to direct the abundant energy on new State life into channels of industry, thrift, and prosperity.

And now let me make memorable this hour, if I can, by bringing into contact the poles of our Eastern and Western civilization, and thus showing how the intellectual and moral energy of one great university has leaped across the intervening mountains and rivers and has blessed new States with the university life and spirit. In 1856, while adventurers were still crowding the Pacific shores, consumed with the

thirst for gold, one of Yale's most distinguished sons went thither in quest of health. Concerning his first experience he writes:

"I am greatly pleased with this country in the matter of natural scenery. The sail up the San Pable and Suisan bays and the straits that connect them, in the decline of the afternoon and toward sunset, with the light streaming down the sides of the green mountains, was magically beautiful. This country is most emphatically a new world. Everything is new and strange. The climate is not a climate, but climates by the dozen. If the immense oaks that grow here and there have scarcely strength to stand alone, what does it signify as regards the future men? Will there be any better stuff in them?" May I not venture to mark this hour and place by saying that this question breathes the spirit and ideal of the true university son wherever his feet press the soil of a new duty or a new opportunity; and may I not also give answer to the voice of him who spake these words of prophetic inquiry, whose lips are still, but whose words still stir "mighty impulsions in sons alive all through with fire of high devotion," that sturdy sons and fair daughters, with a moral fiber unexcelled, are building slowly but surely strong and prosperous States west of the Missouri, States dedicated to a generous culture for the individual and to social well-being for all.

Again this pilgrim son of Yale writes: "If I can get a university on its feet, or only the nest egg laid, before I return, I shall not have come to the new world in vain." How he traveled up and down the shores of the bay of San Francisco and the valleys of the Sacramento and San Joaquin rivers, in search of a location for a university or college that to his mind should be the Yale of the Pacific coast, is a matter of history. But in April, 1860, his first choice for the site of the new college was approved by the board of trustees, and that majestic site, overlooking the bay and the ocean, became the seat of the California college, now the University of California, and the name even was changed from Clinton or Brooklyn to the name sacred in Yale tradition—that of Berkeley. I am sure you will approve this tribute of honor to the memory of Horace Bushnell, who, in the spirit of his alma mater, carried the torch of light and truth to those far-away western hills whose glory is rivalled only by that of the sun which bathes daily our mountain tops and ocean billows in the radiance of beauty and in the majesty of power.

"What kind of stuff are these men and women of the West to be?" queries the prophet from Hartford; "these who, when they have died, will continue to give direction to the thought and conduct of the living?" The question is natural and common to the reflective mind. At this hour and at this seat of healthful educational traditions, in the presence of these representatives of national colleges and experiment stations—both alike educational institutions—I offer the prophet's question in another form: "What is of most worth in modern education—in its spirit, method, organization, and aim?" And the answer, it seems to me, comes from every source of national wisdom and power—here, potent by reason of learning and conviction; yonder, potent by reason of conscience and authority—that the exaltation of ethical values is of most worth in modern education, for the reason that ethical values are fundamental and paramount in the ideas and ideals of modern education—the *ideas* as representing present methods, organization, and spirit; the *ideals* as setting forth the high aims of ceaseless progress toward educational perfection.

The century closes as it began, with an intense and widespread interest in the subject of education. The recognition of its value as a means to modify the course of hereditary dispositions and activities is stronger than ever to-day. Governments have been and are still stimulating their best minds to rational inquiry into educational aims and educational methods with a view to correct national deficiencies and to cure social maladies. The lively interest in educational matters evinced by scientists and statesmen as well as by teachers and men of affairs is an expression of the idea, more or less vague, that the problem of life, which presses for solution at every stage of progress, is to be solved by rational principles and by a knowledge of the truth of things in nature and in man. Under the influence of such marvelous activity the stability of the world and society is preserved by that law of evolution which promotes changes only by slow degrees and requires centuries to accomplish higher results. The dust of the dead gods and ancestors is a fruitful soil that conditions the sentiments and ideas of the living descendants. It is character and not intelligence that determines the historical development of nations and their final destiny. It is character and not intelligence that distinguishes one individual above another and that contributes to social well-being. We may improve the intelligence of a people within the limits of a single generation, but character is in a large degree racial, and centuries of applied effort are required to accomplish new traits of thinking and feeling and willing that shall mark the gain of a new character.

The fundamental importance and the preeminence of ethical values in education pervade the writings of the foremost thinkers of ancient and modern times. The purpose to be achieved by educators of the present time should be to make ethical or moral values the guiding and controlling principle in the application of scientific method to education and to the organization of every school, college, or university. With this view thinkers of the most diverse schools are in agreement. The voice of Socrates in the fifth century, B. C., and the voice of Herbert Spencer in the nineteenth century, A. D., are in accord. It is worth while to recall that the modern school of English scientific men, who give such a high place to science, both pure and applied, in their scheme of education, vies in earnestness with the philosopher Herbert himself in the declaration that the whole aim of education is contained in the one word *morality*. According to Herbert Spencer, "the general problem which comprehends every special problem is the right ruling of conduct in all directions under all circumstances." Mr. Huxley thus preaches: "Begin with the most important topic of all—morality—as a guide to conduct. The child knows well enough that some acts meet with approbation and some with disapprobation, but it has never heard that there lies in the nature of things a reason for every moral law as cogent and as well defined as that which lies in every physical law; that stealing and lying are just as certain to be followed by evil consequences as putting your hand in the fire or jumping out of a garret window. Again, though the scholar may have been acquainted in dogmatic fashion with the broad laws of morality, he has had no training in the application of these laws to the difficult problems which result from the complicated conditions of modern civilization." Says Huxley, further, "Science prospers exactly in proportion as it is religious."

"The basis of education," says Guyau, "is to develop the will, and, *ipse facto*, to form a subject capable of morality. The genesis of morality is preeminently the genesis of the will. Its education ought to be a reinforcement of the will; the will develops its own activity as it apprehends its own powers. The moral will is a power acting along the line of greatest resistance. Hence, the morality of the race, together with its strength and vigor, must be the principal object of education; all else is secondary." This scholarly Frenchman gives us also this beautiful paragraph: "Morality, it might be said, is the serious music of existence; a certain education is necessary before an exclusive appreciation of its charms can be reached, before the sublime rhythm of the morally beautiful is preferred to the trivial dance airs we hear everywhere around us on our way through life."

We may find now in our theme the definition of education and also the criterion by which to judge of the merit of all forms of modern education. Modern education seeks the development and the training of those human powers which make for individual worth and social well-being. The test of every educational scheme, new or old, is found in the inquiry, "Does it give preeminence to ethical values?" We obtain, then, substantial unity in all forms of education. All common distinctions in education consequently lose their significance, except as they may be convenient marks or divisions of effort. There is a solidarity indeed in educational thought and plan. In the elder days the Greek divided education into the practical and cultural, or diagogic. The former applied to winning the necessities of life; the latter to the enjoyment of its comforts. In these later days we have somewhat the same distinction, and around this distinction have gathered contending forces for the ideas practical and the ideas liberal in education. And out of this we have a proclamation of a new education that is to transform methods and surpass former achievements. But the best in the new is but the application and adjustment of the old to meet existing conditions and to solve recent problems. Real progress is conditioned by the best experience and teaching of the race, vitalized by the needs and aims of present experience. We have primary and secondary and higher education, but the essential nature of each in spirit and in method is the same. We have one kind of education prescribed for those who expect to devote themselves to the pursuits of agriculture, commerce, and industry—a practical education, so called—as distinguished from a liberal education for those who have the means and opportunity to secure an education by means of a curriculum of broader range and of philosophic spirit. These distinctions are not valid. They make difficulties where none ought to exist. It is true that we must take life and the conditions of men and women just as we find them. We must recognize in every educational plan that at the base of our civilization are men and women who must be trained to win their daily bread and to rear their children in comfort and in hope; and also men and women who, freed from the anxiety to provide for the primary needs and comforts of life, must be trained to practical efficiency to meet the responsibilities of wealth and power in a society that conditions their comfort and well-being.

The scientific method and the philosophic spirit, the practical aim and the cultured life, ought to be kept in union at every stage of education. To divorce them is to miss, in a measurable degree, the true aim of education. Legislation must needs see to it that there shall be no carelessness nor wrong in the employment of women and children. It will guard against the effect of industrial greed on women. It will protect against the deterioration in the physique of the race. It will not allow, as Ruskin says, "modernism to eat its children early." But at the earliest period that youth may become a wage-earner, up to that period, his education shall not have been simply practical nor unwisely liberal, but shall be the united influence and training force of the practical and liberal which fit him both to work and to live. First and ever a burning inward purpose to be a man, a citizen, an intelligent workman.

But it is just as important that the same union of training for service and of culture for life shall be maintained to the end of the broadest and most privileged education. The failure of a certain percentage of college and university men is due to the fact that this healthful balance has not been preserved in their education. The reproach that has been hurled so often at the college man is due to the fact that in the course of his education he has not been trained to some form of service that touches the demands of the mighty commercial and industrial world. Realism and idealism—these shibboleths of opposing schools—are after all but parts of a common sphere, with now one part and now the other lost in the obscurity of shadowed thought. And it is with accents of confidence that I affirm that this view expresses the very genius of our Anglo-Saxon civilization. I take an illustration near at hand. It is stated upon English authority that "no nation in ancient or modern times ever made such prodigious strides in wealth, population, and power, and, necessarily, in commerce and navigation, as the United States of America during the first half of this present century. Nor is this a matter of surprise. American people commenced their career with the accumulated wisdom of a long ancestry. Their capacity for government, in its application to commerce and navigation, equaled, if it did not surpass, that of the race whence they descended; and their system of education, the only true basis of a nation's greatness, far surpassed that of Great Britain. Hence, in all diplomatic negotiations relating either to their political independence or to their material interests, they have generally exhibited such marked tact, ability, and acuteness, as has enabled them frequently to obtain ample redress from foreign nations. Within eighty years from their declaration of independence they rivaled and indeed surpassed in the amount of their merchant shipping all other nations. American shipowners required of their masters not merely a knowledge of navigation and seamanship, but of commercial pursuits, the nature of exchanges, the art of correspondence, and a sufficient knowledge of business to represent the interests of their employers to advantage with merchants abroad. Education is much prized by citizens. Many vessels, therefore, are commanded by gentlemen with college educations and by those educated in high schools. Nor were the interests of the common seamen overlooked. Boys of all classes had the privilege of entering the higher free school, in which they could be educated for almost every profession. An ignorant American native seaman, therefore, was scarcely to be found." No higher tribute than this can be paid to the character of the education given in these Atlantic coast States—an education which combined in a high degree training for service and culture for social well-being. Another illustration may be given: A year or two since I enjoyed a call upon a well-known railway official at his office in Wall street—a man who has come to his present responsible position from the ranks, knowing every detail of the great railway corporation, from the isolated railway station on the desert to the marshaling of statistics that reveal the exact condition of business and property of a great railway system, and give the knowledge necessary for policies of extension and improvement. In a natural way the topic of conversation fell into the educational groove. When his son, who had been graduated from one of the larger universities, was about to take a subordinate position in railway service, the father gave him substantially this counsel: "When you take your position you will find yourself in association with young men who started into service with only a grammar or high school education. They have been in the railway service several years and will be much in advance of you in experience and training. Do not presume upon your university training. Do not speak of it, but simply do your work the best you can. For several years, perhaps five, perhaps ten, you will find your associates in advance of you, because of the practical experience which they have enjoyed. Be patient. After eight or ten years these young men will begin to feel the limits which the want of technical education has placed upon them, while your strong theoretical training will have full play and you will be able to accept

and discharge the duties of higher positions. You will then realize the freedom and power which your university education and your technical training have given you over the forces that fit you to master difficulties and to guide them."

The importance of the view herewith advocated becomes accentuated when we remember that the limited education of the many as well as the broader education of the few must prepare young men alike to discharge political and social duties and privileges that touch the welfare of the social organization in all that pertains to the joy and beauty of living.

I accept with pleasure the fine interpretation of Senator Morrill's views and purposes as set forth by President Buckham in his admirable address at the last convention, in which he says: "It is to give education—not mere apprenticeship, not mere learning—an education which shall be first liberal, then practical—the best feasible combination of the two—an education which shall be adapted to the needs of those who are entering upon not only farming and mechanical pursuits, but upon all the pursuits and professions."

If ideas be the invisible spring of things and ideals be the projection of the best character upon the field of achievement, then moral values give a national character to every system of education. Our country, whose national history is measured for the most part within the limits of the century now drawing to a close, has developed a system of free education as a means of preparation for such citizenship as will safeguard its free institutions, encourage progress in science, art and industry, and perpetuate its national life. The declaration that all men are created free and equal, as an idea, has become a common sentiment in the hearts of a great people. The affirmation that all men are endowed with certain inalienable rights, among which are life, liberty, and the pursuit of happiness, is a Magna Charta to every citizen's conscience and fireside. The people, united by this strong bond of a common sentiment, look to our system of schools and colleges and universities to preserve liberty and prosperity for themselves and their children and their children's children.

To the possession of common sentiments, common interests, and common beliefs is ascribed the greatness of the Anglo-Saxon peoples. From this common inheritance the Anglo-Saxon people have gained a national character, which is thus flatteringly portrayed by a distinguished French savant: "There is no race, perhaps, in the world so homogeneous as the Anglo-Saxon. The dominant features of his mental constitution from the point of view of character are: A degree of will power which very few peoples, except, perhaps, the Romans, have possessed; an indomitable energy, absolute self-control, a sentiment of independence, immense activity, a very stable morality, and a very clear idea of duty. From an intellectual point of view, a sureness of judgment which allows the grasping of the practical and positive side of things; a strong liking for facts and but little taste for general ideas."

If this high estimate of the character qualities of the Anglo-Saxon people is just, then there is no problem that pertains to individual worth or social well-being that the people of the United States can not solve with reasonable satisfaction as they are presented for solution during the twentieth century. It is only necessary that ethical values shall be given the supreme place in the statecraft, in the education, and in the life of the people, to secure widespread triumph of the best forces in modern civilization. The national will must enforce the national wisdom and the national conscience. It needs only a retrospective glance at the marvelous triumphs of scientific invention and art within the present century to fill our minds with satisfaction over the achievements that have so richly endowed our common life. The research and discoveries of pure science have been followed quickly by the application of these discoveries to the good of man's estate. If pure science has been the wisdom of knowing what to do, applied science has been the virtue of doing it. Industrial training, instead of being an inferior and limited sort of education, has taken its rightful place as an integral part of the truest education. No longer does the hand say to the brain, "I have no need of thee," nor the brain say to the hand, "I have no need of thee." The mutual cooperation between brain and hand, between intellect, sentiment, and will, and the physical power to execute, have come to be applied to the solution of social problems. The conception of a definite order in the universe, giving belief to the law of cause and effect, has brought the teaching that obedience to law brings greater perfection and happiness.

The application of science to agriculture and commerce, to mechanic and industrial arts, has contributed potently to our national progress in wealth, knowledge, and happiness.

Agriculture in the widest sense is the first in time as in importance of all human industries. "The early Egyptians possessed a degree of agricultural knowledge superior to that of many subsequent centuries, and which may even be compared, as regards its absolute results, with our own country in the middle and last centuries.

The Greeks probably received their lessons in agriculture from the Egyptians, and were preeminently food raisers, bread and wine being staples. The breeding of cattle was an important branch in their husbandry. Large herds constituted the sole riches of princes." As Homer sings:

> They never took
> My beeves nor horses, nor, in Phthia's realm,
> Deep soiled and populous, spoiled by harvest fields.

"Among the Romans agriculture and horticulture were considered the most important and profitable occupation. They practiced both irrigation and drainage. The ancient Britons were taught agriculture and the art of gardening by the Romans. We owe to the monks the preservation of agricultural knowlege and practice during the Middle Ages." The development of agricultural knowledge during the tenth and eleventh centuries by the conquering Saracens in Europe was the forerunner of the intellectual renaissance. The application of science and invention to agriculture is one of the significant forces for social well-being at the present time. Our primary wants being better than ever before supplied, better opportunities have been offered for mental culture and better conditions for moral life.

Some of the applications of science have thus been aptly put: "Geology finds the bed of coal, but chemistry tests its value in the market, cokes it, distils from it gas, naphtha, and the aniline colors. Mineralogy selects iron ores for us, chemistry converts them into steel and mechanics convert them into bars and blades. Descriptive botany plucks a wild currant, physical botany changes it into a sweet grape, chemistry ferments it into wine and transforms it into ether. Descriptive zoology lays its hand on the caterpillar, physical zoology nurses it into the strong silkworm, chemistry bleaches and dyes the silk which it spins, and mechanics weave it into ribbon and velvet."

We see therefore through the discoveries and the application of science to agriculture that settled life upon a farm or ranch has become richer in interests and pleasures and has secured the assurance of profits through the intensive culture of the soil and through the constant renewal of its fertility. Notwithstanding that the census of 1900 shows a continuance of the movement toward the cities, yet in the twentieth century the balance will be restored, because the farm is to keep pace in dignity and opportunity and privilege with the town and the city. More than 40 per cent of the wealth of the nation is in agricultural pursuits and property. President Armsby, in his splendid address at San Francisco, in which he emphasized the experiment station as an institution for higher education in agriculture, set forth an idea and an ideal which are to be potential in the future progress of agricultural art and science.

The application of science to the mechanical and industrial arts has been no less beneficial to mankind. It is true that the use of machinery detracted from the craft guilds, and has by specialization in industry for a time transformed the artisan, with his inherited dexterity, into a toiler. It is true that the introduction of machine spinning has brought about social dislocations that for a time, during the period of adjustment, have worked hardship to many people dependent upon their earnings from certain industries. It is true that the drainage of fens, involving the destruction of fish and wild fowl, bore hard upon one particular generation, but it brought good in the long run by freeing districts from chronic ague and converting bogs into rich corn land. The introduction of the cotton gin increased slavery for a time, but slavery is gone and the ultimate results have been beneficial. The feeling that machinery is the enemy of laborers rests on the fallacy that employment is a limited quantity. Following the displacement of workers possessing a special skill in spinning and weaving there was a great increase of the cotton trade as a whole, and hence great expansion of employment. The displacement of the mail coach by the railway train expanded the demands of travel and largely increased the total field for employment. Goods were made more quickly and cheaply and therefore wants increased and were supplied on easier terms. The application of science to invention and art has released woman from much drudgery. Improved educational facilities have, in the manufacture of paper and invention of printing, expansion of sculpture, painting and architecture, made life more stable and distribution easier. It has improved manners through the manufacture of table furniture—knives, forks, glass, and china—thus removing habits of eating inconsistent with our ideas of refinement. It has improved religious worship by improving architecture and making a church building more convenient and useful. It has increased the means of intercourse and thus has reacted on social institutions, removing local prejudices, creating common interests, strengthening forces of organization against anarchy, developing commerce in order to obtain adequate food supply and to dispose of manufactures. It has made war more humane. It has brought about better sanitary conditions through lighting,

paving, and sewerage systems. It has brought about a better business system through the introduction of a money economy, and this is of great assistance in rendering bargains fair between man and man. Rewards for labor are better defined and obligations more certain. One of the ideas pertaining to our country's well-being, which must be worked out in our educational life, is that of social justice and social wisdom as applied to certain conditions of classes of our population. I take for illustration our negro population, clothed, so far as law can accomplish it, with all the rights, duties, and powers of citizens. They possess a distinctively racial character, but modified and improved by their Anglo-Saxon environment. For two hundred years they were slaves in the service of their Anglo-Saxon masters. One-eighth of our population belong to the negro race. This land is to-day also the American negro's land, this country is his country, and the Stars and Stripes are his flag. He has proved himself possessed of the highest virtues of patriotism. He cared for his master's family during the years of civil strife. He never betrayed a soldier nor failed to provide for the escaping prisoner's needs. Unwise legislation, following the gift of freedom to him, made him the prey of designing men, and a limited as well as unsuitable system of education failed to train him properly for his new life. Upon the nation's conscience must rest all censure for the negro's failings and excesses during the twenty-five years following the close of the civil war. The adaptation and application of ethical values to the education of the negro is the beginning of the solution of the race problem in the South. An industrial education which unites both the practical and liberal under the inspiring ideal of a moral aim means for the negro an intelligent apprehension of the personal qualities which must be acquired by him as a prerequisite for true citizenship—such as thrift, skill in some one industrial pursuit, the acquisition of property, the self-respect of a bank account, a will that can deny the gratification of a present instinct for a future gain. These high results can not be secured in a day. But it is the duty of the nation to make the conditions favorable for such education for the negro American people. The vices of civilization will to a greater or less degree check his progress, and outbursts of unregulated instinct or passion may disgrace his color; but in time the strong guiding hand of education will deliver him from his personal and his political bondage.

The American Indian is still with us. Under government and philanthropic control education is measuring arms with hereditary traits in the Indian, and the results seem inadequate and unsatisfactory. The free vices of our Western civilization adapt themselves easily and quickly to the disposition of the red man. He is an inveterate card player and gambler, and the legal restrictions are not sufficiently strong to protect him from indulgence in the white man's "fire water." Vices touch race characteristics quickly, because they minister universally to common instincts and passions. Virtues must have generations to effect a change by education in race character. Yet, as we know the Indian in our Western towns, he is a useful laborer upon our ranches and in our hop fields, and the Indian "mahaly" a valuable ally in our domestic service. The Indian race is not dying out and the Indian problem will remain with the Government for a time, but the education given at Carlisle and the Indian schools scattered throughout the Western States will finally solve the problem for the good of the Indian and the benefit of the nation.

With the close of the century, as between individualism on the one hand and the paternalism in government on the other—a Scylla and Charybdis to some thinkers—socialism moves forth with banners flying, proclaiming a new creed for society's acceptance and a new gospel for the social ills of mankind. Its progress will be determined not so much by the doctrines it proclaims as by the devotion it inspires. Civilization, the mother of progress, creates new wants which can not always be satisfied, and changes industrial conditions, which bring social ill for a time to certain classes. A case in point is that of the condition of agriculture in Great Britain. The interests of England as a great commercial and manufacturing State has brought about economic legislation that has made agriculture less profitable. So that the hope for the prosperity of agriculture in England to-day rests upon the application of scientific discovery and invention to solve the problems which confront her economists. It seems to be clear that as nature seeks to maintain the balance between animal and plant life, so likewise society, by wise legislation, must seek to maintain the balance between the increasing wants and the happiness and satisfaction of men. The high interests of the race or the nation can not safely be left to the influences of natural competition or natural association. Just laws, honestly administered, can, with the aid of a sound national education, maintain for society the conditions that promote general well-being. The all-important question, then, in politics as in education, is the *moral life*. The ethical virtues of justice, courage, honesty, and self-sacrifice are the very warp and woof of individual excellence and national greatness. No price is too dear that makes these the characteristic traits of any people. The

difference between the United States and the South American States is a difference of moral quality. Undue dependence upon government patronage causes certain classes in foreign countries to lose their moral fiber. The control of great cities in these United States by political organizations for personal and party ends contains the seeds of a corruption that menaces the future of the dominant Anglo-Saxon race.

Since writing the above I have taken the following from the press:

"Prof. Felix Adler, in responding to the toast, 'Our patient, the public,' at the annual dinner of the New York State Medical Association, strongly impressed upon the medical men that their aid was necessary in fighting the battle against vice and crime, which he said were ready to overflow their embankments and ingulf the whole city. 'There exists in this city,' he said, 'a moral morass. * * * Is it not your duty to warn the community of the dangers that menace its youth because of the unrestricted, unrestrained vice rampant? There is still some of the old Puritan conscience left to prevent New York from descending to conditions of older European capitals. We want you to help maintain the standard of public morality; aye, we want you to raise it. We look to you to assist quietly but effectively in this great undertaking.'"

A coarse commercialism threatens to dispossess business and professional life of the finer elements of its character. The professions are ofttimes pursued simply as a means to acquire wealth. Business enterprise too often seeks larger profits by the corruption of its goods, and commerce and trade do not hesitate to exploit even patriotism itself.

The colleges and universities of this Association, resting as they do upon the foundation of national beneficence, have resting upon them a solemn obligation to the nation. They are indeed national institutions of learning, and in their plans and systems of study and organization they ought to give prominence to those subjects which will secure the best results in our national life. If, as has well been said, philosophy is the morality of science, and political economy is the morality of industry, commerce and agriculture and natural law the morality of legislation, and social science the morality of history and politics, then these moralities must be the crowning subjects of education in these national institutions of learning. And the essence of these moralities is not to be wanting even in our primary and secondary education. These represent the liberal element that must pervade all technical courses of instruction. Systematic moral teaching demands a first place.

It pertains to the tongue and pen of those who knew Senator Morrill to present in fitting garb of speech the attributes of that noble personality. But I may be permitted to say that the more we study the legislation by which these land-grant colleges were established the deeper insight we have into the noble life and thought of this modern Roman Senator. The inspiration of the blacksmith shop of his father, of the village store around whose stove the politics of the nation were settled, and of the little Vermont farm finds expression in his purpose to found institutions that shall promote the "liberal and practical education of the industrial classes in the several pursuits and professions in life." The technical instruction of the college course shall, according to this, rest upon a liberal preparatory course of studies, and the secondary and primary education in American life shall be related to the needs of one's occupation and to the higher opportunities and privileges of one's citizenship. The preservation of the nation, either from civil dissension or foreign aggression, is regarded as of great moment in the scheme of national education; for military instruction shall be provided in these colleges, so that young men trained for positions as captains of industry and commerce shall also be ready, if need be, to belt the sword or carry the gun in defense of their country's flag. It is to the honor of the universities and colleges of our land that they have always been the nurseries of patriotic sentiments and national faith.

I doubt not that the exalted patriotism of one of Yale's noblest sons abides here as the ideal of the scholar, the soldier, and the patriot. When, one hundred and twenty-two years ago the 22d day of last September, a Yale man, distinguished in his student days for grace of manner, for exactness of scholarship, for devotion to high ideals of living, placed his young life as a sacrifice upon the altar of his country, he gave utterance to the memorable words, "I only regret that I have but one life to give for my country." Nathan Hale had left to the college men of this nation, through all the centuries, an example to be cherished and a patriotic spirit to be emulated.

According to Senator Morrill's ideas and ideals, in this new land labor shall stand on golden feet. In a beautiful story, which was probably founded on fact, Heinrich Zschokke tells how a Swiss family of wandering tinkers and peddlers became, in the second generation, braziers, girdlers, and military accouterment makers, and in the third generation were at the head of a brass and iron foundry, casting batteries for arsenals and bells for cathedrals. They established, moreover, a polytechnic school,

not more for the study and practice of the particular arts required in their own business than for the exposition and inculcation of those principles of integrity and of liberality on which all business of an honorable character must everywhere be conducted. The mechanic and the farmer of this generation may be the capitalists in the second and third, managing vast properties upon which depends the welfare of thousands of men and hundreds of families. The tradesman of to-day may have resting upon him to-morrow the responsibilities of legislation that will make or mar the progress of the nation.

From our secondary and even our higher education, therefore, we must exclude all overparticularizing and all overspecialization. Our first aim shall be to make men endowed with great social virtues. The useful must be incarnated with the true and the beautiful in a personality that shall distinguish our students and that will be accepted as the highest realization of personal and national worth, when it is said, "He is an American citizen."

Morning Session, Wednesday, November 14, 1900.

The convention was called to order at 10 a. m. at Middletown, Conn., in the chapel of Wesleyan University, with President Stubbs in the chair.

The chairman called for the report of the treasurer, which was submitted, as follows, by E. B. Voorhees, of New Jersey:

Report of Treasurer of the Association, July 7, 1899, to November 13, 1900.

RECEIPTS.

Amount on hand July 7, 1899	$1,062.40	
Amount received from dues	1,069.65	
Total		$2,132.05

EXPENDITURES.

Convention Hall, San Francisco	57.00	
Printing and manifolding	59.54	
Morrill memorial	18.00	
Postage	7.00	
Committee on military affairs	133.39	
Committee on revision of constitution	89.07	
Committee on Paris Exposition	129.95	
Committee on graduate study	257.71	
Executive committee	1,267.32	
Overdraft on check No. 60	.10	
Total		2,019.08
Balance on hand		112.97

An auditing committee, consisting of J. L. Snyder, of Michigan; H. W. Tyler, of Massachusetts, and T. L. Lyon, of Nebraska, submitted the following report which was adopted:

Your committee appointed to audit the accounts of the treasurer of this Association begs leave to report that it has compared the books and vouchers of the treasurer and found them to agree, and the said books and accounts appear to be correct.

Your committee recommends that in the future no bills be approved or paid unless carefully itemized and the date given of each expenditure.

By vote of the Association the fee for annual dues remains the same as in previous years, viz, $10.

C. S. Murkland, of New Hampshire, submitted the following report from the committee on engineering experiment stations:

Report of Committee on Engineering Experiment Stations.

This committee was instructed to act in cooperation with the executive committee, and has therefore held itself ready to respond to any call from that body. That it has not been called upon may indicate the status of the project it stands for. It has

not seemed best, during the year, to attempt to secure Congressional action in favor of establishing engineering experiment stations. At the present time the outlook is less favorable than at any time during the past two years, and it is hardly worth while to continue this committee in service. In presenting a recommendation to this effect, your committee wishes to express its conviction that experiment stations for the study of problems in engineering would speedily justify the expenditure necessarily involved in establishing and maintaining them. Much has been said of the enormous waste involved in common agricultural practices. It is one of the commonplaces of our recent history that our agricultural experiment stations have abundantly repaid all that they have cost the people. The economics resulting from the researches of the past ten years have made these institutions good investments, but it is doubtful if the waste in agriculture is at all commensurate with that in manufacture. The great loss of energy involved in producing steam, for instance (something like 90 per cent), is prodigal in the extreme. It is a standing indictment against the mechanical genius of our day, and it touches the people by adding to the cost of every manufactured article. Here is a problem under constant investigation, indeed, but important enough in itself to warrant the employment of engineering experts under the supervision of the Government in experiment stations.

The development of applied electricity suggests more problems than it solves. There seems to be no limit to the possibilities of it and the perplexities of it. To the older problem, one already mentioned, add the newer one of the economical transmission of the power generated. These are simply problems which lie upon the surface. There are others without number, certainly not less vital than those suggested by the gypsy moth and the San José scale. Until one comes in contact with some genuine difficulty he is likely to consider engineering an art having all the exactness of a true science. When he has called in the aid of experts in vain, he learns that it is an empirical science at the best, and in not a few particulars a very bungling empiricism. At a national gathering of such experts, not long ago, a somewhat eminent engineer read a paper, claiming that he had obtained so many units of energy from so much oil used as fuel. The figures are unimportant. Another expert promptly asserted that this gentleman had undoubtedly made the grandest discovery of the century, as he had succeeded, if his claim was true, in getting out of the oil a great deal more than there was in it. But nothing more has been heard of this wonderful discovery.

The incident illustrates the value of such exact knowledge as would be gradually acquired at engineering experiment stations; and, as one result, information of this sort would tend to develop discovery and invention by demanding economy of effort and by discountenancing fanciful projects, such as have appeared from time to time and have induced vast and foolish expenditures. A trustworthy institution in each State would protect the would-be inventor against his own visionary schemes; would give inventors a guarantee or a warning. While it might reduce the income of "patent lawyers" by diminishing the number of worthless inventions, it would increase the number of inventions of direct value to the people.

Perhaps it is not wise to urge the argument from the demand for symmetry in our system of institutions. The force of that argument is not in the demand of the institutions themselves, nor is its weakness in the apparent lack of any other demand for such symmetry. If the industrial interests of the country were as well organized as the agricultural interests, if they could be brought to see how absolutely the seeming diversity of such interests might merge into one common interest, the pressure upon Congress would be irresistible, and the logical necessity of associating the two great national concerns, agriculture and engineering, in allied operations of research would at once appear. But of this there is little hope.

Insisting, therefore, upon the eminent advisability of securing the establishment of such engineering experiment stations at the earliest possible moment, this recommendation is respectfully submitted that the committee be discharged, and that this Association record its judgment that such stations are demanded by the industrial necessities of the age and should receive favorable consideration by Congress in view of the inestimable benefits that would inevitably accrue from them to the people.

Trusting that these recommendations will be adopted by the Association, your committee respectfully submits this report.

CHAS. S. MURKLAND, *Chairman.*

The report was accepted and its recommendations adopted, the committee being discharged.

President Raymond, on behalf of Wesleyan University, delivered a brief address of welcome to the Association, to which President Stubbs responded.

W. H. Jordan, of New York, delivered the following address:

American Agricultural Experiment Stations.

It has long been the custom of the preacher to announce a text. Perhaps this time-honored practice of the pulpit may be imitated without impropriety on the platform. Certainly I can honor this occasion no more fittingly than by prefacing what I may say with words taken from the introductory pages of a book which, since 1868, has been greatly useful to students of agricultural science. This is what the distinguished author of this volume wrote more than thirty years ago: "He will not call it a misfortune that other duties of life and of his professional position have fully employed his time and his energies, but the fact is his apology for being a middleman and not a producer of the priceless commodities of science. He hopes that circumstances may put it in his power to give his undivided attentfon to the experimental solution of numerous problems which now perplex both the philosopher and the farmer; and he would earnestly invite young men reared in familiarity with the occupations of the farm, who are conscious of the power of investigation, to enter the fields of agricultural science, now white with a harvest for which the reapers are all too few."

These words must appeal to us with great significance when we remember that they were written in the State of Connecticut by a well-known scientist, who afterwards became a director of America's first experiment station, and who lifted up his voice when there were few to listen and fewer to believe. They are the expression of a noble sentiment which is both a declaration of an exalted purpose and an invitation to a high calling. They sound the keynote of the experiment station movement.

I present this quotation from the introductory pages of "How Crops Grow," because it serves most admirably to call attention to an influence that was mainly operative in the inception and development of our experiment station effort. I refer to the spirit and faith of a few men—apostles of science, investigators, teachers.

Surely, experiment stations were not established because the farmers, in the beginning, asked to be instructed in science. On many occasions in former years agriculturists were warned against its delusive and ensnaring theories, endangering both the soul and the pocketbook, and they were distrustful of its practical utility. It can be said truly that, in the early days which the veterans of this Association are able to recall, the common people did not with one accord sit under the teachings of the scientist and hear him gladly. In this, as in every great movement of human affairs, we must pay tribute to the words and work of a few leaders. And so, my friends, because of our pride in our magnificently endowed and widely influential experiment station effort in this nation, and because it is well to hold up to young men an inspiring example of the reward of devoted and loyal service, we gladly and with gratitude make mention of the names of the American pioneers in the domain of agricultural science, whose labors attended the inception and birth of the agricultural experiment station movement. Listen to the roll: Norton, Johnson, Brewer, Storer, Cook, Goessmann, Pugh, Roberts, Caldwell, Hilgard, Shepherd, and Ledoux, and so on down the line. Later, and as the legitimate first fruits of the instruction and inspiration of these earlier teachers, appear the names of Atwater, Babcock, Jenkins, Armsby, Voorhees, Neale, Henry, Dabney, and many others.

I should come short of adequately recognizing the rights and courtesies of this occasion if I failed to point out the prominent place which the State of Connecticut holds in this roll of honor. Under the guidance of Professors Johnson and Brewer, of the Sheffield Scientific School, investigations bearing upon agricultural practice were carried on to a limited extent at New Haven more than thirty years ago, and it is but just to declare, in the language of another, that "through the influence of the professors and pupils trained in this school, more than to any other single cause, is due the recognition of the importance of the establishment of agricultural experiment stations, first in Connecticut and subsequently throughout the whole country."

We are grateful to these first teachers and investigators, because as in our text they not only declared their devotion to experimental research in the interests of agriculture, the encouragement of which their labors have so abundantly justified, but they led many young men to an active faith in the dignity and importance of an honest inquiry after truth, and to a prophetic vision of the profound influence which a wider knowledge of the principles of chemistry and biology would have in promoting human welfare. They were centers from which radiated enlightment and conviction concerning the importance of science to the common affairs of common life. Many of them were trained in Europe and they brought to their own country definite knowledge of methods of research and organization which served as a guide to our early efforts of investigation.

If we stop and look deeper into fundamental causes, we shall see that these students of nature were but the exponents of a great movement of thought and development as old as the history of the inductive sciences, which, despite the blighting influences of scholasticism and dogmatism in the early days, has maintained its hold upon the human mind; a movement whose rapid progress and beneficent fruition have characterized the century now closing, one which the evolutionist might well regard as the persistent and irrepressible impulse of the human species to cast off the limitations of its former state by mastering the forces and conditions which attend all its activities.

Let us now come a little closer to the facts and incidents around which our attention and interest gather at this time.

This is the twenty-fifth anniversary of our first experiment station, and we do not forget that to the State of Connecticut belongs the honor of establishing it, and that this institution, whose name and fame are to this city and to this State an occasion of just pride, generously opened its doors that the new enterprise might have an abiding place and the facilities for carrying on its work. As I touch briefly upon the beginnings and history of this experiment station, I shall be pardoned, I trust, if I make allusions which are more or less personal.

In the spring of 1873, at which time I was a sophomore in the Maine State College, now the University of Maine, there appeared on the campus of that institution a new professor of chemistry. Whatever may have been his views on the subject, I am sure he was regarded by his new associates as a young man on the road to a successful career. He had received his academic training in this stronghold of sound learning on whose campus we are met; he had pursued post-graduate studies with Dr. S. W. Johnson, at Yale, had enriched his knowledge and broadened his outlook by a residence at the universities of Germany, and had returned to his own country full of enthusiasm and ambitious dreams.

He did not remain long to cultivate the intellectual soil of Maine, for at the end of one term his alma mater wisely called him into her service. But that short period of labor was full of reward, both to himself and to others. I can bear personal testimony that Dr. Atwater succeeded in creating in the minds of his students great respect for qualitative chemistry and the conjugations of irregular French verbs. He did more than that—he accomplished what is the highest function of the teacher by inspiring some of the responsive members of his classes with a desire to know truth, and to seek truth for truth's sake.

It was not long, we may believe, after Dr. Atwater's return to Connecticut before he was found in the midst of an agitation for the establishment of an experiment station. He was fortunate in the field of effort into which he entered. Here was a State whose agricultural thought had for years been cultivated by able men and within whose borders science had already justified herself in many ways. Here too was a large-hearted citizen, the Hon. Orange Judd, who was ready to materially aid a progressive step by a liberal contribution of money. Here was an institution, this university, alive to its opportunities and to the demands of progress.

With this combination of circumstances in its favor, and aided by scientist and farmer alike, the proposition to establish an experiment station was brought to a successful issue in the legislature of 1875; and thus to Connecticut came the well-deserved honor of initiating an effort which has grown to be of vast importance. The State made an annual appropriation of $2,800, to be supplemented by $1,000 from Mr. Judd, and the control of the station was vested in the trustees of Wesleyan University, whose laboratories were to furnish the necessary facilities. Prof. W. O. Atwater was elected director, and work was actually begun on January 1, 1876, three months after the date when the money first became available.

In 1877 the State took the station somewhat more formally under its fostering care and provided for its permanent establishment with an increased appropriation. It was located at New Haven. Dr. S. W. Johnson, who has so long and so ably served the agriculture of Connecticut, was made its director, and from its first until its latest day this station has been to us an illustration of dignified, able, and useful work. Those who are familiar with its published records know how orthodox have been its principles, how catholic its spirit, and how thorough its investigations.

It should be counted as fortunate, for two reasons, that this experiment station fell into good hands. In the first place, its standards and methods could not fail to have a formative influence upon similar institutions subsequently established in other States. When, for instance, it was proposed to organize stations in North Carolina, in 1877, and in New Jersey, in 1880, a close-by demonstration of usefulness and success could but be regarded as a source of information and an example to be followed in all good things. In the second place, a somewhat remarkable number of men who assisted in the early work in this State came to occupy prominent positions in

stations organized at a later date, and they must have carried to their fields of labor something of the standards and methods with which they came in contact at Middletown and New Haven.

It is a notable fact that six of the present station directors in the United States were connected with the staff of the Connecticut institution during the first five years of its existence, five of these taking more or less part in the work that was carried on at Middletown during the first three years. Another assistant became a professor of agriculture and others came to occupy important positions as chemists. More than this, a gentleman who is now the successful president of one of New England's land-grant colleges, while an undergraduate student and an instructor in Wesleyan University stood under the drippings of this early effort, and evidently absorbed so much of its spirit and purpose that he afterwards was led to become Director of the Office of Experiment Stations and had much to do with shaping the activities of that very efficient and indispensable bureau. Surely, all this is an honorable record for the institution that led the way in the days of inexperience and doubt.

The other day there appeared at the New York Agricultural Experiment Station a distinguished German scientist, Dr. Oscar Hagemann, who has been associated with Zuntz in conducting some of the most remarkable and important researches in animal nutrition that have so far been instituted. When this learned gentleman told me that he was in this country mainly to study the respiration apparatus located at this university and the one of similar construction soon to be completed at the Pennsylvania State College, my pride was stirred in reflecting that at the end of only twenty-five years of our organized effort Germany is coming to the United States for instruction. This incident must have for many of you, indeed, for all of us, interest and gratification when we consider the fact that this old-world investigator, in order to accomplish his purpose, must make a pilgrimage to the building and to the very rooms which were the first home of our first experiment station.

It was not long before the example set by Connecticut in 1875 was followed by other States, and so rapidly did experiment stations increase that at the end of the year 1886 no less than twenty-one existed in the United States under one form or another.

In 1887 occurred the passage by Congress of what we speak of as the Hatch Act. Many members of this Association have not forgotten the anxiety with which we watched the progress of that measure. Those of us who had struggled with the vicissitudes and uncertainties of State legislation hailed with delight the prospect of relief from the discouraging and sometimes disheartening limitations which had beset us. Our hopes have in a good measure been realized, and to-day, after thirteen years' experience we have every reason to regard this exhibition of generous governmental paternalism as by far the most important event that has occurred in the history of our agriculture, excepting, of course, the Morrill Act of 1862. A recognition of this fact should bring with it a corresponding recognition of the men who were in the forefront of the struggle that was crowned with victory. We come again to pay a just tribute to leaders—men of courage, men of action—men in whom was combined with knowledge great ability in affairs and an unflagging zeal. They were not turned aside by the objections of the uninformed and narrow-minded, and they were not dismayed by difficulties apparently insurmountable.

I mention names in this connection with hesitancy, so many were there who, according to their opportunity, aided in bringing about the enactment of the experiment-station law. There can be but a single opinion, however, about the part played by one leader in securing this legislation. It is not necessary to declare his name in this presence. We very fittingly speak of the national station law as the Hatch Act, and in the name of the agriculture of the United States we are bound by fact, as we are by every just sentiment, to give a large place to-day to the memory of the lamented William H. Hatch. He was certainly the farmer's friend and advocate in the halls of legislation. At the time of Mr. Hatch's last appearance for renomination to Congress the following statement appeared in a prominent agricultural paper of Missouri, giving cogent reasons why he should be held in high esteem by his farmer constituency:

"The agricultural experiment station act, resulting in the establishment of agricultural experiment stations in all the States of the Union, to meet the expenses of which $15,000 is annually given to each State, introduced and pressed into passage by Mr. Hatch, ought of itself to be enough to secure for him the increasing good will of farmers. And when in addition to this we place to his credit, where it belongs, the authorship of the oleomargarine law, the law creating the Department of Agriculture and making its head a cabinet officer, and his later, and we hope yet success-

ful, fight for the antioption law, to say nothing of his most valuable assistance as chairman of the Committee on Agriculture in aid of minor bills and general appropriations for the Agricultural Department, it should make every farmer honor and revere his name."

One other tribute to this man has come into my possession from the highest possible earthly source, from the heart and memory of a wife. I quote from a letter recently written by Mrs. Hatch in response to inquiries on my part: "Such a man as Colonel Hatch was does not often leave much account of himself in private sources, being always too busy about the weal of others to take notice of himself. I love to testify to my husband's nobility of heart and brain."

There are other men to whom we owe a debt of gratitude. This is notably true of the members of the legislative committee appointed by the convention of delegates from agricultural colleges and experiment stations which was held in Washington in July, 1885. In the selection of that committee Commissioner Coleman, as presiding officer, showed great good judgment. He named three college presidents—President Atherton, of Pennsylvania, as chairman; President Willits, of Michigan, and President Lee, of Mississippi. Only those who know from personal observation what was the immense labor of organizing and leading the effort which resulted in the passage of the Hatch Act can appreciate the signal ability and devoted service that these gentlemen gave to the cause that was intrusted to their care. We congratulate ourselves to-day that the chairman of that committee, Dr. George W. Atherton, practically the author of the Hatch Act and the head and front of the battle for its passage, is still with us, as we trust he may be for many years, to continue the wise counsel from which this Association has so long profited, and we render our tribute of gratitude to President Stephen D. Lee and to President Edwin Willits, the latter of whom passed into the mystery of death after a life of eminent usefulness.

But this committee did not work alone, for it had the effectual support of such able helpers as Dr. George H. Cook, Prof. W. H. Brewer, and others who rendered distinguished services. In every State, in fact, some one stood ready to respond to a call for assistance either at home or in Washington. Farmers' organizations, notably the Order of Patrons of Husbandry, lent powerful aid in influencing legislation, and so with wise leadership and the united support of progressive agriculturists throughout the entire country the battle for larger knowledge was waged and won.

And now, meeting here as we do, at the end of twenty-five years of experience and observation since the first experiment station was planted on American soil, in what direction shall we turn our thoughts that we may rightly estimate our past efforts and gain encouragement and guidance for future endeavors? Certainly there would be little profit in considering in detail the history of our stations, either individually or collectively, even if it could be accomplished within the limits of a single address, for this has been done admirably and with great completeness in Bulletin No. 80 from the Office of Experiment Stations. Putting to one side, then, the mass of facts that might be displayed to show the magnitude of the work which this Association represents on the experiment-station side, we may wisely ask ourselves whether so far we have achieved all that we should in broadening the boundaries of agricultural knowledge, and whether the present organization and activities of the stations are calculated to produce in the future the results we have a right to expect.

To many there appear to be very good reasons why these questions should receive serious and unprejudiced consideration, and I ask your indulgence while I attempt to discuss them. If I do this with considerable frankness, I trust I shall not be misunderstood, for I assure you that I am not unmindful of the ability, constant devotion, and, in many instances, gratifying success with which experiment-station workers have met their responsibilities all over this land. They have much to show for their labors, the resultant of which as related to the progress and present status of our agriculture constitutes a magnificent achievement.

We shall be pardoned, I am sure, if just here we indulge in a little self-congratulation by recounting briefly some of the general ways in which, without boasting or vainglory, we may rightfully claim that our own agriculture has been materially benefited by our own experiment stations. Primarily there has been a material gain to those departments of scientific knowledge which sustain important relations to the practice of agriculture. Our basis of correct thinking has been encouragingly broadened. The practice of agriculture has been a direct gainer. The bag of fertilizer is no longer a mystery or an uncertain quantity. Through it dishonesty may not now disastrously prey upon the farmer's pocketbook. The sources of gain to the fertility of the farm have become better understood, and the avenues of loss; and much has been learned concerning the influence of specific methods of plant feeding. This is knowledge fundamental to a people's permanence and prosperity.

In the domain of animal nutrition we can guard the cattle feeder against at least

the worst forms of fraud in commercial feeding stuffs, and within broad lines can point out what is valuable as compared with what is inferior. Our by-product feeding stuffs, peculiar to our manufactures, have been studied both as to composition and digestibility. We are able also to indicate closely enough for the demands of practice equivalent rations when derived from unlike sources, and thus make possible uniformity of feeding according to certain standards. The influence of feeding upon the resulting product has been studied with decided advantage.

The dairy industry has been established upon a safe and businesslike basis, solely through the means which the stations have provided for accurately measuring the relative manufacturing and commercial value of milks of different composition. Some men who keep cows and who buy cows' milk have, perforce, adopted a new system of ethics. Dairy wastes have been diminished, and the causes of inferior butter and cheese have been pointed out.

The spraying outfit is on every well-conducted farm and in every well-managed fruit plant, efficiently controlling the ravages of many plant diseases and injurious insects, and for this the experiment station should receive almost all the credit. Much has been done in pointing out useful and useless varieties of forage plants and fruits. All along the line certainty is supplanting tradition, and sound reason is taking the place of opinion. These are benefits on the side of better business methods, but these are not all. Because the intellectual and social status of the farmer and his family is a matter of supreme importance to us as a people, the highest utility of the experiment station lies in the impetus which it is giving to what may fitly be termed the rise of intellect in agriculture. Possibly the spread of scientific information is making the farmer's art more complex, and a working knowledge of it harder to attain, and if this is so it is good, for it means the maintenance of agriculture in a position of dignity and respect.

If we wish to throw this picture of progress into bolder relief, we have only to project it against the background of conditions under which the experiment-station effort began in the United States twenty-five years ago, conditions which exist, only to a less extent, to-day.

In the first place, there were few available men prepared for the work of investigation. We were suddenly called upon to do something, and in doing it we have been receiving the necessary training. Moreover, the agricultural public did not have, and could not have, an intelligent conception of just how the stations could best serve its interests. Some farmers believed too little, some believed too much. At first they had no conception of the time element in reaching safe conclusions; they showed often a lack of discrimination as to what properly should be required of an experiment station, and they held conflicting views as to the relative value of different kinds of effort. For years there was a necessary strenuous effort at securing public favor and legislative good will, and so wisdom often waited on expediency. All the time there has been the disheartening and often inexcusable misinterpretations and misapplications of station results both by the press and by the practitioner; yes, even by men who were supposed to speak in the name of science. It is a matter for sincere congratulation that in the midst of all these hindrances so much real good has been secured.

But let us not take too much unction to our souls. We should remember the biblical injunction, "For unto whomsoever much is given, of him shall be much required; and to whom men have committed much, of him they will ask the more." The citizens of this nation have good reason to expect that the 55 stations, employing nearly 700 persons in their staffs and expending annually over $1,200,000, shall accomplish much; and if we are able to point to substantial achievements it is no more than the people have a right to demand.

But the question returns, Have we planned wisely, and are our efforts wholly to be commended?

The success of any institution like a college or experiment station depends primarily upon its means of support and its manner of organization and administration. In these particulars station workers in this country have some very good reasons for rejoicing. It is certainly fortunate that the stations' means of support is derived from the General Government. This arrangement secures for the work a possible permanence and continuity along well-considered lines not otherwise assured. It is not now so necessary, as would be the case if the funds came from annual appropriations by State legislatures, to expend time and energy in watching the vagaries of public or individual opinion. Mr. Blank, who fancies that his business has been injured by public statements, or his pet notions unkindly assailed by certain station conclusions or his political desires ignored by friends of the station, can not now take revenge by attacking an appropriation bill in the committee room or in legislative debate. Independence of action is necessary for the wise management of an experi-

ment station, not only as to the time element in carrying on its researches, but also as to the free and untrammeled declaration of its conclusions.

There is one other notable reason for thankfulness that our experiment stations are the subjects of national legislation. I refer to the relation which they sustain to the Department of Agriculture through the Office of Experiment Stations. It is not easy to overestimate the usefulness of this office as a means of coordinating our efforts and of making available the results reached, not alone in this country but throughout the entire world. No more useful administrative office exists in all our official agriculture, nor one where abler and more conscientious service is rendered.

When we come to consider the general organization of the stations themselves within the several States as departments of the land-grant colleges, there is much that may be said. Theoretically this arrangement is the ideal one, but in practical operation it can not be regarded as so far wholly satisfactory. I am of the opinion that the Hatch experiment stations, established as a means of experimentation and research and for no other purpose, are, to some extent, suffering from conditions which should be changed. If you will consult Bulletin No. 80, of the Office of Experiment Stations, you will learn that in 1899 these stations, including those endowed by the States, employed 678 persons in the work of administration and inquiry. The statement is there made that 308 of these do more or less teaching in the college departments. On the face of it this seems to be a very good showing.

But the situation should receive a little closer analysis. A careful examination of the organization lists for 1899, as shown in Bulletin No. 74 from the Office of Experiment Stations, reveals the fact that in 47 stations which are departments of colleges, 277 persons are either directors or heads of the various lines of scientific work, of which 241 are members of the college faculties of instruction. It also appears that of the 47 directors, 7 have no other duties, 11 are also college presidents, and 29 are teachers, generally the heads of some important department of instruction. I am perfectly aware that in some instances the teaching duties of station workers are merely nominal, but I am also convinced that in a great majority of cases where a double duty is required the demands of the class room take by far the first place in the time consumed and in the energy expended. Permit me to quote from a former paper read before this body: "Teaching is a task which must be met at appointed times, enforcing preparation which in science laboratories is extensive and involving that expenditure of nervous energy which good instruction peculiarly demands. Interruptions are at the expense of inquiry work, and if weariness comes, investigation suffers rather than teaching. There are no times and seasons in which a truth must be laid bare. If it can not be accomplished this year the possibility of doing it constitutes a hope for another year."

Now, my proposition is, that the interests of our stations and, above all, the interests of our agriculture demand that the director and leading members of the staff shall be first of all workers for the station, and shall give to its proper activities their highest thought and their best energies. Consider, for a moment, what a large place an institution of this kind ought to fill. Because of the growing confidence which farmers place in it it is, as it ought to be, the arbiter of many troublesome questions.

If a new fertilizer or cattle food appears in the State the chemist should promptly become acquainted with it. If a new plant disease or injurious insect threatens the farmer or fruit grower, the botanist or entomologist should at once give all possible aid. If the dairy industry is suffering from bad practices or untoward conditions, the chemist, bacteriologist, and dairy expert, one or all, should grapple with the situation and try to lead the way out of the difficulties. If a new fruit claims attention the horticulturist should seek it out. In short, station workers should be alert to all that is occurring in which they can possibly be of service.

The markets should be watched, plant disease and injurious insect surveys should be carried on, practical observations should be made in the butter and cheese factories, and familiarity should be secured with the practical and commercial horticulture of the State. And all the time a determined and persistent attack should be kept up before the citadel of many great problems, the solution of which would be the greatest possible gain to agriculture. I am ready to take the chance of successful contradiction when I assert that no department of any college or university is more important than the experiment station, or may be made to stand closer to the welfare and prosperity of the people of a State.

Shall such a department be given less consideration than others at least no more important? Does any well-regulated president of a decently endowed college believe it to be wise to split his professor of civil engineering into one part of engineering, one part of geology, and one part of mathematics, or the professor of chemistry into one part of chemistry and one part of some related science? Is there any reason

why such a policy would be bad for one department and good for another? It is entirely out of the question for our college professors to be tied to the insistent daily duties of instructing students and at the same time maintain a close, well-informed, and broadly helpful relation to the needs and conditions of agricultural practice. The experiment station, with an annual income second to no other department in most colleges, should not be in any sense an appendix to class-room instruction, nor was it ever intended that this should be the case. It should have a strong, well-defined, and independent individuality.

But above all, I plead for a station director who is that and nothing more. In the multitudinous duties of administration, in the broad relations which he should sustain with the agriculture of the State, in deciding upon the most useful lines of work, in the sympathetic attitude of encouragement, and if possible, of inspiration, which he should maintain toward his associates, there is abundant opportunity for the full exercise of the largest ability and the most untiring energy. If there is any official in our land-grant colleges other than the president who should not be halved, it is the station director.

Some one may be inclined to ask at this point whether the management of the stations is not justified by the results which they have secured. This is a hard question to answer, because it is not possible, perhaps, to determine just how much they ought to have accomplished. Some indications of the nature and distribution of their efforts may be gained, however, by an examination of their publications and in this way we may also learn something of the drift of effort. A short time since I asked an associate, Mr. F. H. Hall, to assist me by making a careful analysis of the station bulletins for 1890, 1891, 1898, and 1899, upon the following basis: Bulletins of record, bulletins of inspection, bulletins of compilation, bulletins of practical experiments, and bulletins of research. The results of this analysis are presented in tabular form on the basis of both the number of bulletins and the number of printed pages.

Character and distribution of station bulletins.

[Forty-seven stations.]

Years.	Number of bulletins.	Number of pages.	Percentage distribution.				
			Record.	Inspection.	Compilation.	Practical experiments.	Research.
1890–91	523	.....	10.7	6.3	24.9	44.6	13.6
	.....	9,538	6.0	6.0	25.1	49.8	13.1
1898–99	667	.....	4.8	13.3	33.1	34.3	14.4
	.....	15,431	2.1	11.4	36.3	30.8	19.4

As inspection of various kinds is mostly supported by State funds, the character of the work sustained by the Government appropriation is more clearly seen by excluding from consideration the bulletins of inspection, and the figures which follow are from calculations made in this way.

Character and distribution of station bulletins exclusive of those relating to inspection.

Years.	Number of bulletins.	Number of pages.	Percentage distribution.			
			Record.	Compilation.	Practical experiments.	Research.
1890–91	490	.....	11.4	26.5	47.6	14.5
	.....	8,960	6.6	26.7	52.9	14.0
1898–99	578	.....	5.6	38.2	39.5	16.7
	.....	13,668	2.3	40.9	34.8	22.0

In a few instances, matter mostly of a scientific character published in annual reports and nowhere else does not enter into the foregoing analysis, but this is perhaps offset by a very generous interpretation of what constitutes a bulletin of research. To me this display of the direction in which our stations are using printer's ink is instructive and very suggestive as I hope it will be to you.

Passing by the literature of record which is useful in giving the facts of organization and administration, we come to note that in eight years the proportion of literature

of inspection has doubled. The number of stations carrying on inspection in one form or another has also doubled, being fifteen in 1890 and 1891 and thirty-one in 1898 and 1899. There is evidently a decided movement toward a closer scrutiny of those articles of commerce important to the farmer and to the general public which offer an opportunity for the practice of fraud. This is certainly a movement in the right direction, provided all official inspection is sustained by State appropriations. It is high time that the inroads of commercial greed upon our business and physical well-being should receive a check all over the land.

There is a dangerous mercenary spirit abroad, the shadow of which Ian McLaren declares is resting upon us as a people, whose code of ethics holds nothing to be sacred but money getting. The men who manufacture fake fertilizers, adulterate feeding stuffs and human foods, use food preservatives injurious to health, and in so many other ways deceive the purchaser by false claims, must be controlled. Our individual welfare demands this, our business reputation as a people will suffer unless it is done, and where can it be done so well as in our stations. To me such inspection, with or without the express authority of law, the results of which are made known in unbiased and fearless utterances of station men, has much of promise. It is a nucleus of effort, and practically the only effort of its kind in the United States, around which it is hoped that our business interests and our moral energies will ultimately rally to compel, so far as possible, a reasonable compliance with the methods of honest dealing.

The bulletins which, in this study of station publications, are regarded as literature of compilation, are those made up wholly of a restatement of existing knowledge and not containing anything new which is the result of inquiry by the institution issuing the publication.

Attention is called to the fact that in 1890 and 1891 one-fourth of the bulletins distributed were of this character and in 1898 and 1899 one-third. If we eliminate the bulletins of inspection and consider only the publications more especially within the province of the Hatch stations, it is seen that in 1898 and 1899 38 per cent of the bulletins issued and 41 per cent of the pages printed had no other purpose than the diffusion of existing knowledge, this being a marked increase in this kind of literature since 1891.

In commenting upon this, it should be said, first of all, that under certain conditions bulletins of information possibly may be regarded as legitimate or at least as expedient. Immediate information is often demanded concerning some unfamiliar article of commerce, a fertilizer, a feeding stuff, or an insecticide, or concerning an industry new to a State. A sudden and serious onslaught of an injurious insect or a plant pest may justify a prompt and widespread statement of related facts. It is often necessary, also, to illuminate some proposed line of inquiry by a presentation of the knowledge already possessed in order to show why the investigation is undertaken and what are its relations to practical agriculture.

I am unable to agree, however, with those who argue that the chief function of an experiment station is to promote, not the acquisition, but the diffusion of information.

To be sure, the preamble of the Hatch Act contains the words "to aid in acquiring and diffusing * * * useful and practical information," but the specifications in section 2 of what a station shall do offer no hint that it is expected to be a bureau of extension teaching. Section 5, which specifies the appropriation, clearly states that the money shall be used "for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results." No other use of money is mentioned or even suggested.

But we need not refer to legal limitations in order to set this matter in its right light. The idea fundamental to the organization of our stations is plainly expressed in the word "experiment." Our common understanding tallies with this word and always has. Unless, therefore, we revolutionize our views and agree to a new definition of terms, an experiment station, when it carries its instructional and literary efforts beyond what is necessary for properly exploiting the results of its inquiries, steps outside its natural and legal field and encroaches upon the province long recognized as peculiarly belonging to the college or university in its extension-teaching capacity. An experiment station chiefly as an instrument of popular instruction is an absurdity. As such it is not needed. If, then, our literature measures the present distribution of energy, it is to be deplored, not only that so much compilation is regarded as necessary, but that the proportion of this class of bulletins appears to be materially increasing when it ought to be decreasing. Whether this should be regarded as due to a confusion of thought, to reasons of expediency, or to a dearth of experimental results, I shall not attempt to decide.

There may be several reasons for the evident decrease in the proportion of effort directed to practical experiments, which in the early days received such generous attention. It is to be hoped that this change is in part due to more discriminating views as to the proper limitations of such experiments. Their great importance as a means of adjusting science to practice is unquestioned. It is largely through this kind of effort that farmers have been brought into sympathy with science as a means of progress.

Observation teaches, however, that we should guard against centering an experiment around facts or conditions which are of mere local or temporary importance. The literature of agricultural science is already cluttered with so-called practical conclusions that in a brief time will be swept into the rubbish corner, there to lie unremembered and unused. We all agree, I am sure, that practical experiments, whether illustrative or otherwise, should, so far as possible, deal with matters of general and permanent utility, and we must have become convinced that the planning and execution of work of this sort so as to avoid erroneous deductions and teach lessons of real usefulness is a most difficult matter.

Let me conclude by calling your attention to the fact that anything like scientific research, which is worthy of the name, occupies a decidedly minor place in our station literature. Ten years ago nothing else could have been expected, because of inexperience, reasons of expediency, and other conditions pertaining to the newness of the work, and we ought to be satisfied if now we can perceive an unmistakable drift of energy toward the highest and most useful function an experiment station can exercise. Is such a drift plainly perceptible? In some quarters, but to a disappointing extent in general. We have not yet risen to the high conception of our duties and responsibilities as ably set forth in the presidential address of Director Armsby. We are not yet a source of abundant nourishment to the higher education. The pages of our reports and bulletins so far contain comparatively little that will find a permanent place in records of scientific and industrial progress.

Shall we not be taught by history and experience? Can we not see that the contributions to knowledge which have entered into the warp and woof of agricultural practice are those which have been proclaimed from the inner temple of science? Search the libraries of the world and the experience of men and you will find that the discoveries of scientific truth which are to-day blessing the farmer in his daily toil are mostly those which have been reached through the severest and most searching investigations. The stations can most surely aid agriculture by laying foundations, and for these we must dig deep. When a really important fact is established, we need have little concern about its ultimate utilization by farm practice. It is easier to cut a diamond to its setting than it is to find it. We can trust the ingenuity and business ability of our progressive agriculturists to assimilate in time all that is of real benefit to their calling. In fact, this part of progress is largely in their hands, no matter how much we stimulate their efforts by illustrative experiments.

There is perhaps no occasion for entering at this time into a critical discussion of the details of station administration, further than to mention one serious fault, which there is a general disposition to acknowledge.

Reference is made to the division of our energies into numerous and interrupted lines of inquiry without following any one of them in an exhaustive way to a conclusive finish. How often do we find, in attempting to compile the knowledge pertaining to a question supposed to be reasonably well answered, that there are many weak or imperfect links in the chain of evidence or that the chain was begun and all its links were not forged. We are able to point to some pieces of American investigation that are models of thoroughness and completeness, and these are they which, in the time to come, will be to us a source of the largest benefit and satisfaction.

Those to whom the administration of our stations is intrusted can do no better than to carefully consider what are the more important problems waiting to be mastered and then besiege them until they capitulate. We can not afford to longer content ourselves with easy dashes at the easy things. We must set ourselves at the large and difficult problems which we have avoided because they looked so formidable.

The foregoing suggestions are not made in the spirit of censoriousness. I am mindful of the difficulties which boards of trustees and college presidents have met in the administration of the institutions under their care where consideration of expediency and the adjustment of greatly varied and sometimes conflicting interests have caused a necessary departure from the ideal conditions. Doubtless we have all done what we thought was wisest and best under the attendant circumstances, but there should be a constant pressure toward the ideals which in some particulars I have tried to set forth.

Friends, and coworkers, the record which our experiment stations make is a matter of great moment to the members of this Association. We represent by far the most

ambitious and extensive scientific effort in which the people of this nation are to-day engaged. Our ideals, our intelligence, our integrity of thought, and our ability, in things scientific, will be judged by the outcome of our labors. Our patriotic pride, no less than the interests of the great industry which we serve, demands that our standards shall be the highest.

In the closing years of the century about to end we have been laying foundations deep and broad upon which we may build, if we will, a superstructure, so grand in proportions and so beneficent in its uses that the whole world will be compelled to admire our achievements. May the spirit of truth and of just discrimination so possess us that when the great clock of the universe shall sound its hundredth stroke and summon us to the work of a new day, we shall carry with us the wisdom and purpose essential to the right use of the opportunities that are entailed upon us.

W. A. Henry, of Wisconsin, offered the following resolution:

Resolved, That it is the judgment of this Association that the director and the heads of divisions of station work should, if possible, devote their whole time to the work of investigation. If this is impossible, then it is essential to good work that such heads of divisions shall spend their best efforts in the station work and act secondarily as teachers in a limited way. If there is to be a combination of investigation and instruction, then the investigator shall direct the instruction and not the instruction direct the investigation.

The resolution was referred to the executive committee, but reached their hands too late for action.

W. O. Atwater, of Connecticut, addressed the Association as follows:

The Connecticut Experiment Station.

To Connecticut belongs the honor of establishing the first agricultural experiment station in the United States. This institution began its work in the chemical laboratory of Wesleyan University in 1875. Experiment stations had already been in operation in Europe for twenty-five years. Their success in promoting the interests of agriculture by scientific investigation had been so marked that similar institutions were being established in other countries. Efforts in the same direction were being made in the United States. In Connecticut, especially, the public had been gradually educated up to the idea by the labors of such men as Profs. John P. Norton, S. W. Johnson, and W. H. Brewer, of Yale University, and T. S. Gold, secretary of the Connecticut State Board of Agriculture.

In 1873 a definite movement in this direction was started in a meeting of the State Board of Agriculture when Professor Johnson, of the Sheffield Scientific School and Professor Atwater, of Wesleyan University, urged the establishment of an agricultural experiment station in this State. A committee was appointed to press the matter and meetings in the interests of the enterprise were held in different parts of the State. A proposition was brought before the legislature of 1874 and again before that of 1875, but only a few farmers took an active interest in the enterprise. When it became apparent that the leglislature would not grant the appropriation asked for, Mr. Orange Judd, of the American Agriculturist, then a resident of Middletown, offered, on his own part, $1,000, and on the part of Wesleyan University, the free use of the chemical laboratory in Orange Judd Hall, which had been given by him to that institution. These offers were made on condition that the legislature would appropriate $2,800 per annum for two years for the work of the station. It was urged that in this way the usefulness of such an enterprise would be demonstrated and that it would then receive generous and earnest support. Stimulated by this the legislature unanimously passed an act making the appropriation thus proposed. The act was approved July 2, 1875. In October the work began. Professor Atwater was made director, the services of chemical assistants were secured, and thus the first agricultural experiment station organized in America was an accomplished fact.

At the end of the two years provided for in the original bill the faith of the promoters was justified by the facts. Notwithstanding the severe financial depression of 1887, the legislature of that year passed, without a word of opposition, a bill making a permanent annual appropriation of $5,000 "to promote agriculture by scientific investigation and experiment." The station was organized under the direct control of the State and permanently located in New Haven. The laboratories of the Sheffield Scientific School were thrown open for its occupation until 1882, when separate buildings and grounds were provided by the State in the suburbs of that city. Prof. S. W. Johnson was director from 1877 until 1899 when, on his resignation, Dr. E. H. Jenkins, who had been connected with the institution since 1876, was made director.

The example set by Connecticut in 1875 was soon followed in other parts of the country. Within a dozen years some twelve experiment stations in as many differ-

ont States were in successful operation. So great was the usefulness of the enterprise that in 1877 Congress made the enterprise national by the passage of the so-called Hatch Act, which appropriated $15,000 per year for each State and Territory in the Union for the establishment of experiment stations. The $15,000 given to Connecticut was divided between the State Experiment Station in New Haven and the Storrs Agricultural School. The trustees of the latter institution, finding that the more abstract inquiries could be best carried out at an institution possessed of large scientific equipment, requested Professor Atwater, of Wesleyan University, to undertake the directorship and carry out the chemical work in his laboratory. The trustees of Wesleyan University assented, and in 1888 the Storrs Station was established under his supervision, the agricultural work being carried out in connection with the State institution at Storrs and by cooperation with farmers in different parts of the State. In order to more successfully coordinate the work of the stations in various parts of the country, to render needed assistance, and to collate and disseminate the results of their inquiries, Congress provided for a central scientific bureau in connection with the Department of Agriculture at Washington. This was established in 1888. Prof. W. O. Atwater was made the first director, and carried on the work for several years while still retaining his connection with Wesleyan University and the two experiment stations in Connecticut. When this task became too heavy, he retired from the directorship of the Office of Experiment Stations. Mr. A. W. Harris, a graduate, and for a time member of the faculty of Wesleyan, had been assistant director, and was appointed director, remaining in the office until his resignation, in 1893, to become the president of the Maine State College, now the University of Maine. At that time Dr. A. C. True, likewise a graduate and former member of the faculty of Wesleyan, as well as successor of Mr. Harris as assistant director, was made the head of the Office, and still occupies that position.

The growth of the experiment station movement has been very remarkable. There are now 57 of these institutions in operation in all the States and Territories, and in Alaska and Hawaii. An appropriation has already been made for the establishment of a station in Porto Rico, and one in the Philippines is also in contemplation. The total income for the year 1900 was $1,170,857.78, of which $720,000 was received from the National Government and the remainder from the State governments and other sources. In addition, the Office of Experiment Stations had an appropriation of $45,000. The stations employed in that year 693 persons in the work of experimental and scientific inquiry. The movement has become the most important of the scientific enterprises which our nation has undertaken and the most extensive of the kind undertaken by any nation. To-day the experiment station in the United States is almost as firmly established as the public school. This is not simply because of the material benefit it brings to the farmer, but also because of its educational influence—the intellectual uplift which it gives.

The pioneers who more than a quarter of a century ago did the work which led to the establishment of the first experiment station in Connecticut little thought that a quarter of a century would bring such fruit from the seed they tried to sow.

To the friends of Wesleyan University and the people of Middletown and vicinity an especial object of interest is the connection of Wesleyan University with the enterprise. The list of men who have been connected with the experiment station work at Middletown, and since holding prominent positions in other institutions, includes Dr. A. T. Neal, of Wesleyan, 1873, who left Middletown to become chemist of the New Jersey Experiment Station and was afterwards made director of the Delaware Experiment Station, which position he still holds. Others are Dr. E. H. Jenkins, who has already been referred to, and is now the director of the Connecticut Experiment Station; Prof. Walter Ballantyne, for several years and until his lamented death, the very efficient and useful professor of agriculture and chemist of the Experiment Station and the Maine State College; Prof. E. P. Voorhees, of Rutgers College, director of the New Jersey Experiment Station, and Prof. W. H. Jordan, formerly director of the Maine State Experiment Station and for a number of years past the director of the New York Experiment Station, which is the largest institution of the kind in the world.

Another graduate of Wesleyan who has been prominent in connection with experiment station work is Prof. C. D. Woods, of the class of 1880, who was for a number of years associated with Professor Atwater as assistant in the chemical laboratory and was chemist and vice-director of Storrs Station from the time of its establishment until 1896, when he was made director of the Maine Experiment Station, and professor of agriculture and dean of the agricultural department of the Maine State College, now the University of Maine. A number of other gentlemen who have been in the past connected with the chemical laboratory at Wesleyan have become prominent in other institutions. Among these are Prof. John H. Long,

since professor of chemistry at Northwestern University and in the Chicago Medical School; Prof. Milton Whitney, now head of the Division of Soils, Department of Agriculture; Prof. George P. Merrill, the curator of the National Museum in Washington, besides a considerable number of still younger men who are rapidly coming into prominence.

One outgrowth of the experiment station work is found in the food and nutrition investigations which were begun in the chemical laboratory of Wesleyan University, afterwards taken up by the Smithsonian Institution, the United States Fish Commission, the United States Department of Labor, the Storrs Experiment Station, and, finally, by the United States Department of Agriculture, with the aid of a special appropriation from Congress. The State of Connecticut also makes a special appropriation in aid of this inquiry. The headquarters is in the chemical laboratory of Wesleyan University. Those carried out by Congressional authority are in charge of Professor Atwater as special agent of the Department of Agriculture. The scientific work is carried on at leading educational institutions and experiment stations in different parts of the United States, though the chief center is at Wesleyan University.

The time was when the higher institutions of learning were interested chiefly in what belongs to purely intellectual culture. They have come to learn that what most takes hold on life is most worthy of their highest effort. They include in that effort to-day not simply the classics, the mathematics, and the other so-called humanities of the olden time, but the larger list of subjects of human thought and action, the humanities in the truer sense, and the subjects in which the mind of man busies itself with those things which help to the larger culture of mind and heart and the improvement of the physical, the mental, and the moral condition of mankind.

LATER HISTORY OF THE CONNECTICUT STATION.

The period of trial thus passed, the period of great success began. The law under which the station was permanently organized provided that its management should be vested in a small board of control. One was to be chosen by the Sheffield Scientific School and one by Wesleyan University, thus providing for the higher scientific and educational element in its policy and management. The agricultural interests were represented in the choice of one member by the State Board of Agriculture and one by the State Agricultural Society. The responsibility of the State was recognized in the appointment of two members by the governor, with the advice and consent of the senate, and in the provision that the governor himself should also be a member. In a State like Connecticut, where partisan politics have very little to do with the administration of public trusts, this plan has proven safe and wise, and finally, the fact that a director of a station should have a share in its general administration was recognized by making the director also an ex officio member of the board. The money is placed in these men's hands to manage as their wisdom, their experience, and their public spirit shall decide.

When this act was passed the Sheffield Scientific School, then the agricultural and mechanical college of the State, provided accommodations for the station in its laboratory. The newly organized board selected for its director the Nestor of American agricultural chemists, Professor Johnson, and he chose for assistants two of his former students, Doctors Jenkins and Armsby. As since that time I have had no further share in the management than belongs to a member of the board of control, I hope I shall not seem unduly boastful in referring, as I do, with pride to the notable success and steady growth in resources and influence which it has since that time enjoyed.

When, after long years of usefulness, the director some months ago resigned the management, the board and the friends of the station felt themselves still fortunate in being able to appoint to his place Dr. Jenkins, who for many years, as vice-director, had borne a very large share of the responsibility. The full confidence which the community and the State legislature have continually placed in the station is evinced by the generous sums which have been given from year to year to provide buildings and equipment and to increase the amounts available for current expenses. When the Hatch Act had been passed, the $15,000 coming to the State of Connecticut was by act of the legislature divided, one-half being given to the State station and the other half to the Storrs Agricultural School, now the Connecticut Agricultural College, for the establishment of a station under the auspices of that institution.

A citizen of Connecticut, who had been greatly impressed by the usefulness of the experiment stations, made provisions in his will by which at his death, which occurred not long since, his estate, valued at nearly a quarter of a million dollars, was bequeathed to the station—one-half at his death and the other half on the death of a residuary legatee.

In what the station has been in the past and what it now is we find abundant promise of its constantly increasing usefulness. It examines fertilizers and feeding stuffs and seeds; it identifies grasses, weeds, blights, mildews, and useful or injurious insects; it watches and exposes the adulteration of foods; it makes diversified experiments in its chemical, botanical, mycological, horticultural, and entomological departments; it studies the growth of plants and the effects of fertilizers in the greenhouse and in the field; it cooperates successfully with individuals and organizations of farmers in experiments in different parts of the State; it supports a grass garden of remarkable interest under the management of a special agent, and it is about organizing experiments in forestry. Nor is it in the least forgetful of the importance and the claims of abstract research, as is proven by special inquiries in its chemical and other laboratories.

Fortunately free from the disturbances of party politics, situated close to one of our leading universities, with the great advantage of access to its libraries and of constant association with its specialists, enjoying the full confidence of the community and the liberal support of the legislature, it comes very near to realizing the ideal of the American agricultural experiment station.

THE STORRS STATION.

When in 1888 the trustees of the Storrs School found themselves face to face with the responsibility of organizing and maintaining an agricultural experiment station, without the special advantages which the State station enjoyed, with its laboratories and other equipment and its close connection with a great university, they were naturally anxious that in some way their station should come as near as possible to holding its own alongside of the stations which enjoyed such advantages. Hesitating to ask the State for gifts of money to provide them, they came to Wesleyan University and asked its professor of chemistry to assume the directorship and prosecute the chemical inquiries in his laboratory. With the cordial encouragement of the board of trustees, the proposal was accepted and arrangements were made by which the agricultural work should be done at Storrs under the immediate charge of the Storrs School. Mr. C. D. Woods, who had been for some years assistant in the chemical investigations at Wesleyan, became chemist and afterwards vice-director, and in due time Professor Conn, of the University, was led to undertake bacteriological studies which had an important bearing upon the dairy industries.

Of the work of this station it is hardly fitting that I should speak. How some of it is done we hope to have the privilege of showing you to-day.

At the request of the convention, Professor Atwater gave an account of the respiration calorimeter and of the nutrition investigations in progress at Wesleyan University.

Evening Session, Wednesday, November 14, 1900.

The convention was called to order at 7.40 p. m., President Stubbs in the chair.

H. J. Wheeler, of Rhode Island, submitted the following report of the committee on uniform fertilizer laws:

Report of the Standing Committee on Uniform Fertilizer Laws.

During the year the committee has been in correspondence with parties in several States where new laws were about to be enacted or where the existing laws were to be amended. In each case copies of the resolution adopted by the Association at Washington, D. C., in 1898, were forwarded to those interested, and the arguments for drafting or amending the laws in accordance with this resolution were presented. It is reasonable to believe that by persistent efforts in this direction much may be accomplished in the line of securing greater uniformity. The many calls upon the financial resources of the Association have not seemed to justify any expenditures on the part of the committee for the purpose of attempting to secure national fertilizer legislation. It is, however, possible that your committee may yet find it practicable to lend certain aid to such a movement.

H. J. Wheeler, *Chairman.*

The report was accepted.

The report of the committee on graduate study at Washington was presented by A. C. True.

Report of Committee on Graduate Study at Washington.

In order that the Association may have a clear understanding of the recent action of the committee on graduate study, which forms the main subject of this report, it seems necessary to briefly review the earlier work of the committee. The committee originated at the meeting of the Association held at Minneapolis in July, 1897. Its first report was presented to the Association in November, 1898, at the convention held at Washington, D. C. In this report the committee made the following recommendation:

"It submits tentatively, however, that Congress might be asked to provide for the establishment of an administrative office in Washington, preferably in the Smithsonian Institution, in which graduate students of the institutions we represent, and others as well, might be enrolled and directed to the appropriate department."

Some of the reasons which led the committee to think that the Smithsonian Institution might appropriately be the center for this enterprise were pointed out at the same time. The Association approved the recommendation of the committee, which thus felt itself instructed to make an effort to secure the cooperation of the Smithsonian Institution in this undertaking. Therefore, in December, 1898, a full report of the proceedings of the Association in this subject was communicated to the Secretary of that Institution, and he was asked to bring this matter to the attention of the Regents. In this communication, after a statement of the action of the Association, the following request was made:

"The committee further earnestly request you and the Regents of the Smithsonian to intimate to us if the Institution would accede to what is the first preference of all the educators who have been consulted—the establishment of an administrative office in the hands of the Regents and Secretary of the Smithsonian Institution. If the Regents will consider the proposition, the committee would like to have the Regents exercise full power as to the entire plans for the organization of said administrative office. In case of favorable consideration, the committee would be glad to know what steps the committee should take further."

This communication was laid before the Board of Regents at its annual meeting in January, 1899, at which time the following resolution was passed:

"*Resolved*, That the communication from the committee representing the agricultural colleges of the United States be referred to a committee of Regents to be appointed by the Chancellor to consider the same and all kindred questions, and to make a report thereon at the next meeting of the Board."

The Chancellor appointed the executive committee, consisting of J. B. Henderson, William L. Wilson, and Alexander Graham Bell, and also J. B. Angell and R. R. Hitt. The Secretary, at his own request, was not made a member of the committee.

This committee held the matter in abeyance nearly a year, but finally—

"A joint meeting of the committees on graduate study of the Regents of the Smithsonian Institution and of the Association of American Agricultural Colleges and Experiment Stations was held December 27, 1899, in Washington, D. C., at the residence of Mr. J. B. Henderson, at his invitation. There were present of the Regents Messrs. J. B. Henderson, A. Graham Bell, and R. R. Hitt; of the Association, M. H. Buckham, president of the University of Vermont; H. H. Goodell, president of the Massachusetts Agricultural College; Alexis Cope, secretary of Ohio State University; J. H. Washburn, president of the Agricultural and Mechanical College of Rhode Island, and A. C. True, director of the Office of Experiment Stations."

At this joint meeting your committee presented a tentative outline plan for a bureau of graduate study in the Smithsonian Institution, and set forth some of the reasons why that Institution should undertake the management of such a bureau. Subsequently, January 11, 1900, the secretary of your committee, President Harper, of Chicago University, as a representative of the National Educational Association, and Secretary Langley, of the Smithsonian Institution, met at the home of Regent Alexander Graham Bell and discussed this matter. At this time a brief memorandum was made by President Harper and Dr. True, embodying the points of agreement between the committees of the two associations, as follows:

"(1) That the Regents of the Smithsonian Institution ask the Congress of the United States for a special appropriation for the work of research and investigation, to be conducted under their supervision by persons properly qualified therefor. Such work to be so conducted as to utilize the libraries, scientific collections, apparatus, and laboratories owned by the United States, and in charge of the officers of the United States, for investigations and researches, under regulations to be prescribed by the said Regents, and as far as shall be mutually agreed upon between the said Regents and the heads of the several Executive Departments of the Government, the Librarian of Congress, Commissioner of Labor, Commissioner of Fish and Fisheries,

and the Secretary of the Smithsonian Institution, with a view of carrying out the policy of Congress, declared in the joint resolution of April 12, 1892.

"(2) That the Regents ask the general public for gifts of money, to be used in providing buildings, laboratories, equipments, and endowments, for purposes of instruction, such instruction to be limited to students who are graduates of properly accredited institutions, or those who are otherwise properly qualified, it being understood that it shall not be the purpose of the Smithsonian Institution to confer degrees of any kind in connection with such instruction.

"(3) That the Regents formulate a plan for the appointment of an advisory board, the members of said board to represent the leading educational institutions of the country, with a view to securing the active cooperation of the colleges and universities of the country in carrying on this enterprise."

This and other papers in the case were sent to Secretary Langley by Dr. True, who also had another personal interview with Regent Henderson and Secretary Langley just before the meeting of the Regents, January 24, 1900. When the Regents met a full report on this subject was made to them by Mr. Henderson, chairman of this committee, which concluded as follows:

"And now, in conclusion, your committee does not hesitate to express its warm and decided sympathy with the general purposes of the movement thus made for your consideration. The object sought commends itself to us all, and the zeal and ability with which it has been pressed upon our consideration by the very able and distinguished educators and scientists connected with these colleges furnish ample assurance that the consummation of the great and leading object sought by them is only a question of time. The material already collected in the bureaus and departments of the Government furnishes a rich mine of educational wealth that will not be permitted to remain forever undeveloped. This material is now being constantly enriched by the most valuable additions to its present enormous wealth. Already it has invited to the national capital many distinguished scientists, anxious to avail themselves of the superior advantages thus offered for investigation and research.

"Your committee, however, is painfully impressed with the fact that the powers of the Smithsonian Institution as at present organized are scarcely broad enough to embrace the work proposed. And the committee is equally impressed with the fact that even with enlarged authority its present financial condition would absolutely prevent anything like efficient and creditable performance of the work contemplated.

"It is well known to the members of this Board that a great wealth of material—material which would be of immense utility in the successful accomplishment of the purposes indicated by the associated colleges—lies buried in the crypts and cellars of the National Museum.

"If our Institution is unable for want of room, as it undoubtedly is, even to place this valuable material on exhibition for the public eye and as little able to arrange it for scientific uses, the problem of providing halls for lectures and meeting the necessary expenditures incident to the work proposed becomes serious and formidable in the extreme.

"Your committee is not prepared to make definite recommendations to the Board for its final or ultimate action.

"That which is clearly inexpedient to-day may become not only expedient but eminently desirable to-morrow.

"If in your judgment the committee should retain its powers and report progress from time to time in the future it will be our highest pleasure to comply with your further demands."

Without taking any action on this somewhat indefinite recommendation of its committee, the Board of Regents adjourned subject to the call of the Chancellor.

No further meeting of the Board has been held. Further consideration of this matter will probably not be had at the earliest until its next annual meeting in January, 1901, and it now seems very unlikely that favorable action can be secured from this Board at any time.

In February, 1900, a joint meeting of your committee and that of the National Educational Association was held at Chicago. As the result the committee of the latter association formulated a report in which it took the position that in case the cooperation of the Smithsonian Institution could not be secured an effort should be made to organize this work in connection with the Bureau of Education.

Meanwhile the Secretary of Agriculture, encouraged by the attitude and action of this Association regarding graduate study at Washington, has inaugurated a plan by which graduates of land-grant colleges are admitted to the Department of Agriculture as student aids in its work, and have, at the same time, favorable opportunities for study and research on their own account.

In accordance with this plan graduates of these institutions are registered at the Civil Service Commission and are appointed as "scientific aids" in the Department of Agriculture as openings occur to utilize their services in connection with the work of the Department. The term of service is limited to two years and the maximum compensation is $40 per month. A number of graduates have already been appointed from this register, and their work has been so satisfactory that the Secretary and other officers of the Department regard the outcome as quite encouraging. Congress has approved the policy of the Secretary in this matter by formally recognizing the appointment of "scientific aids" in the appropriation bill for the Department for the current fiscal year.

In view of the improbability that the Smithsonian Institution will adopt the suggestions of this Association regarding the organization of a bureau of graduate study, your committee recommends that the Association take no further action in this direction.

The committee also believes that for the present further advantage should be taken of the foundation already successfully laid by the Secretary of Agriculture, and it therefore recommends that the Association express its appreciation of the practical efforts which he has made on behalf of this movement, and ask him to consider the practicability of enlarging the present plan for graduate study in that Department, and, if he deems it wise, to invite the cooperation of other departments of the Government, in order that wider opportunities may be open to the graduates of the Institutions represented in this Association, as well as other institutions, to engage in graduate study and research in connection with the work of the National Government.

C. W. Dabney, of Tennessee: Mr. President, there is no subject before the American scientific public at this present time which surpasses this one in importance.

Anyone who has been in Washington knows of the enormous amount of scientific material, as described by the committee and acknowledged by the report of the Smithsonian Institution, laid away in the archives and vaults of the Departments at Washington. There is no other such storehouse of scientific material in America, and it is of the utmost importance in my judgment that this material should be made available to the public. It belongs to the public and should be available to it. Now, it seems to me that we might as well say a few things frankly upon this question.

The Smithsonian Institution was founded for the diffusion of knowledge in America, but for reasons unknown it seems that it is not prepared to take the leadership in this matter. It is a matter of sincere regret to every American scholar that such should be the case. I am sure that this committee has felt justified in making this report. We are not free to discuss the wisdom of it, because I feel sure that such a report would not have been made unless the facts amply justified it. It seems that American scholars must look elsewhere for that which they have had a right to hope for from the Smithsonian Institution, the institution of learning to which we have all looked to take the leadership in these matters, and to which we have a right to look as the great storehouse of science in America, and, to a certain extent, of the science of the world. We can not but feel great disappointment at the report which we have heard to-night from that great and distinguished body.

I think at the same time we should encourage those who are trying to open this great storehouse of science and history and scholarship to American students. At the present time there appears to be but one Department in Washington which is disposed to do anything in this direction, and that is our own. That is the Department of Agriculture, and it would seem to me, therefore, extremely proper that this Association should adopt a resolution commending the Secretary of Agriculture most heartily for his efforts in opening up his Department for the students of America, and I think we should encourage him and uphold his hands to the best of our ability in this great work which he has undertaken.

M. H. Buckham, of Vermont. While the Smithsonian Institution has not formally closed negotiations with the committee of this Association, none of us have any expectation that it will ever do anything. In fact, from the very first moment, it was clear to me that they would not cooperate with us in this enterprise. We may,

I think, therefore consider that avenue closed, and, as Dr. Dabney has said, the attitude of the Secretary of Agriculture is so cordial, and the outlook in that direction is so hopeful, I am sure we will all agree that, under the circumstances, the recommendation of the committee is the best thing to be done.

The following resolution was offered by Dr. Dabney:

Resolved, That the report of the committee on graduate work be received and adopted.

Second. That the committee be continued, and instructed to pursue its efforts to secure a bureau in Washington for the administration of graduate work by students of our colleges.

Third. That this Association heartily indorse the action of the Secretary of Agriculture in opening his Department to the graduates of our colleges, and that we promise him our earnest support in carrying out that policy.

The resolution was adopted.

On motion of President Buckham, C. W. Dabney, of Tennessee, was added to this committee, and A. Cope, at his own request, was replaced by W. O. Thompson, of Ohio.

The following report of the committee on cooperative work between stations and the Department of Agriculture was presented by E. A. Bryan, of Washington:

Report of Committee on Cooperative Work Between the Department of Agriculture and Experiment Stations.

Your committee on cooperative work between the stations and the Department of Agriculture would respectfully submit the following report:

The committee has sought for an expression of views both from directors of experiment stations and from persons connected with the Department. A very general and free expression has been secured, from which it has become evident that the matter is one of great interest and of far-reaching importance. The attitude of the present Secretary of Agriculture toward closer cooperation between the Department and the stations, and toward more systematic arrangements for such cooperation, meets with very general approval from directors of experiment stations. The perfecting of a system of cooperation in all its details will require time, and it is quite beyond the power of the committee, without further consideration, to present a definite programme. The most it can hope to do is to suggest such general considerations and principles as may, with the approval of the Association, serve for future guidance in cooperative experimentation.

The term "cooperation" is a somewhat loose one, suggesting all degrees of mutual helpfulness, from the formation of a "card index" to station publications, on the one hand, to acting as an agent in seed distribution, on the other. In the opinion of the committee, however, the immediate end in view in the formation of this committee was the establishment of a satisfactory basis for what we might call "joint experimentation." Many cases in which the work of the Department supplements the work of the stations, or vice versa, can not be called "cooperative work" in the above sense. It is not the business of your committee to define the functions of the Department. But as the Department would seem to be the only feasible channel through which the stations can ordinarily secure foreign seeds and plants, for which purpose a corps of expert agents visiting all parts of the world is essential, the securing of such seeds and plants for the stations, together with any relevant facts as to their propagation, is to be looked upon as a legitimate function of the Department and as a service to the stations, rather than as an example of cooperative experimentation. On the other hand, when a station consents to test for the Department certain new seeds and plants in which it is not otherwise particularly interested, it should be looked upon rather as a courtesy extended to the Department than as a case of joint experimentation, requiring mutual expenditure of funds.

Another type of cooperation is that in which the facilities at the disposal of either institution is not sufficient for completion of the work without the help of the other. Such, for example, would be the case in which the Department furnishes a tobacco expert to Connecticut temporarily, or a case in which it completes some chemical analysis to which the equipment of a station might not be quite adequate; or, for instance, on the other hand, the assistance rendered by the Arizona station to the Department in the introduction into the United States of the date palm, an experiment of such magnitude as to be quite beyond the capacity of a State station and of such importance as to make it a national affair.

A third type of cooperation is the case in which work of a purely scientific and somewhat abstract character, involving large expenditure and a number of investigators, has been undertaken by the Department. In such a case it is not unlikely that men of especial fitness for the investigation will be found here and there in the colleges and experiment stations who do not wish to sever their local connections. In such case their services are to be secured, and facilities are to be placed at their disposal as the particular circumstances seem to require, and they are to be looked upon, in so far, rather in the light of special agents of the Department. Such, for example, are the nutrition investigations of Dr. Atwater and Dr. Armsby.

A fourth type of cooperation is seen in those investigations which require the combined work of many stations, as, for example, an attempt to obtain definite information on the changes produced in plants by environment and the value of this factor in plant breeding, or the study of the varying effect of soil and climate in some single crop, or the migration of birds, etc. Such experiments call for the work of many stations at the same time. It is manifest that the uniformity and efficiency of the work would require that such cooperation be arranged and supervised by some central organization, and it is equally manifest that the Department is best prepared to undertake the task.

But the most important type of cooperation, so far as the present consideration is concerned, is perhaps the joint experimentation engaged in by the Department and the individual station. The principles, however, that apply in this case are applicable very generally in cooperative work. Your committee would deem it desirable that both the Department and the station should feel entirely free to propose joint experimentation or to decline a proposal for such work.

It is very clear to the committee that the autonomy of the stations should be preserved, and that the stations should in no sense become extensions of the divisions of the Department for purposes of experimental work. Not only is the autonomy of the stations necessary to the fulfillment of their function, but autonomy in scientific investigation is equally essential. Your committee would therefore deem it desirable, where cooperative work would seem advisable, that the agreement take the shape of a formal contract between the station as such and the Department as such, through the properly authorized channels of each; that is, that the high contracting parties be the station on the one hand and the Department on the other. Arrangements between individual officers in the two institutions are deemed inadvisable except under such contract.

The cost of cooperation should be borne jointly by the station and by the Department, and the amounts to be expended should, as far as practicable, be definitely agreed upon and specified.

While it is understood that an absolute guaranty of continuance can not be given, yet there should be reasonable mutual assurance of a fixed policy until the completion of the work undertaken.

The results of the investigation should be available to both institutions, priority of publication being a matter for mutual agreement at the outset. In all cases publications should set forth that such work is the result of joint experimentation.

Your committee deems it desirable that independent work be not undertaken in the several States by the Department without the knowledge of the station or consultation with the station, particularly along lines of investigation in which the State station is engaged.

Whenever cooperation with practical men in the States is desired by the Department in investigations, it is suggested that the State station be the agency through which such cooperation is conducted. For example, if the Department wishes to distribute seeds or plants for cooperative work, the knowledge both of men and physical condition on the part of the station should be made available.

Your committee makes the above suggestions realizing that they are in no wise complete and that the subject is one requiring further inquiry and consideration.

Respectfully submitted.

E. A. Bryan, *Chairman.*

Consideration of this report was temporarily postponed (see p. 72).

The Chairman. Ladies and gentlemen: The time has arrived for the special order, which is the address by President Atherton upon the life and services of the late Senator Morrill. A few weeks ago I had occasion, after years of neglect, to take down my copy of the Iliad of Homer from the library shelves and for the first time in many years to read those immortal measures which gave me both pleasure and insight into the quality of the poem which I did not gain in my earlier student days. I was especially attracted by the nature of the association which existed between the

allies, between the Greeks and the Trojans, and in the dialogue between the chiefs, man and man. As I read I began to understand what it was in Homer that caused his works to live in literature. After all these years, when Greek is forgotten, this immortal literature still lives as the inspiration of modern literature. We find, as you will remember, how the allies turned to their wise men for counsel. We also are doing that now. We have had to turn to our wise men, to our Nestors, who have been associated with us in the work and progress of this Association from its beginning, and to whom we young and less experienced men are delighted in these days to turn for comfort. Homer further taught me that it takes a man to know a man. So this Association, in its wisdom, has appointed one of its most honored members to present to this gathering the life and services of that distinguished member of the Senate, the friend and counselor and administrator of great interests in this country now represented by this Association. You have chosen a man with experience and wisdom to present to us a picture of this great man, Senator Morrill. I have the honor to introduce to you for this specially distinguished service the Hon. George W. Atherton, president of the State College of Pennsylvania.

G. W. Atherton, of Pennsylvania. Mr. president, and ladies and gentlemen: If I could fulfill the measure of the words of compliment which have been expressed by the president of the Association, I should even then fall short of my conception of the life and character of him I shall attempt to outline this evening. My great regret is that someone who could measure up more fully to the standard of Senator Morrill has not been chosen to present his name and his works to this Association at this time; but I count it as one of the chief honors of my life that I have been asked to speak to you of one whom I knew so well and whom I revered so much.

The Legislative Career of Justin S. Morrill.

The career of Justin S. Morrill is a conspicuous and brilliant illustration of the training power of free institutions.

He belonged to the "plain people." He was the son and grandson of a village blacksmith. At his death there were gathered to do him honor the President of the United States and his Cabinet, the Supreme Court of the United States, the General of the Army and his staff, the diplomatic representatives of foreign countries, Senators, Representatives, officials of every grade, and men and women of every station in life. And the gathering was not a perfunctory meeting of routine and formal officialism; it was a great assembly of those who had known and loved and honored the man, and to very many of whom his death brought a deep sense of personal bereavement. The flowers that covered his bier were the offerings of unaffected love. The tears that were shed fell warm from the heart.

The causes of this wide contrast between the lowly beginning and the stately ending this sketch will try to show.

Justin Smith Morrill was born in Strafford, Vt., April 14, 1810. He was the eldest in a family of ten children, and was early inured to habits of industry and thrift. His grandfather, in 1795, was among the hardy and aggressive settlers who followed close in the wake of that earlier generation of pioneers who wrested the little State of Vermont from between the conflicting claims of New York on the one side and New Hampshire on the other. These pioneers, occupants of a nondescript territory—neither colony, province, State, nor nation—had imbibed the spirit of the thirteen colonies, and had borne their full share in the perils and triumphs of the Revolution, declaring themselves, January 16, 1777, a free and independent State. They had no representation in the convention of 1787 that framed the Constitution of the United States, but afterwards adopted it and were admitted into the Union in 1791, being the first addition to the original thirteen States under the new Constitution.

The grandfather (Smith Morrill), with his wife, five sons, and two daughters, joined in the new movement of population that had been stimulated by the admission of Vermont, and moved from Massachusetts into the northeastern section of the State, settling in what is now known as Orange County. The five sons settled in Strafford, a part of them in what was known as the Upper Village and the rest in the Lower Village, Nathaniel, the father of Justin S., being among the former. One note of the thrift and sagacity of this family group is found in the fact that, besides carrying on the ordinary trade of blacksmithing with its one man, hammer, forge, and anvil, they made use of a swift mountain stream that ran through the two villages to drive

in each a trip hammer, and thus established in that rural community one of the beginnings of iron manufacture in this country, turning out for the use of farmers in the vicinity such rude implements as the simple needs of the time required.

Justin S. lived in his father's home the ordinary life of a country boy, with such sparse privileges as country boys then had, picking up what fragments of knowledge he could in the district school. This was supplemented by two terms at Thetford Academy, one of those institutions which did so much during the first half of the present century to deepen the foundations of a solid education, and a few of which seem to have tasted the fountain of immortal youth. His school education ended when he was 14 years of age. His services were needed to help support the growing family, and he was hired out to work in a store in the village at a salary of $30 for the first year and $40 for the second. On the completion of the contract he engaged in a similar service in Portland, Me., where he remained four years. At the end of that time his former employer in his native village (Judge Harris) made him a partner, Judge Harris furnishing the capital and young Morrill managing the business. After about fifteen years of active and successful business, he was able to retire with a modest but sufficient fortune, purchased a tract of land abutting on the village street, cultivated and improved it as a farm, erected a house, married a wife, and settled himself, to all appearances, as a quiet, unostentatious, retired business man, who could afford to spend the remainder of his life in the undisturbed enjoyment of such simple and wholesome pursuits and pleasures as his fancy might select.

His career seemed thus to be practically completed. He had succeeded at an early age in reaching a position which most men expect to reach, if at all, at the end of a much longer and severer period of toil. We do not find that his success awakened the slightest trace of envy in any mind. His courtesy in dealing with customers, his absolute and unvarying integrity, his gentle helpfulness toward the lowly and the less fortunate, his genial sunniness of temper, his watchful and intelligent study of the needs of the community, and his foresight in anticipating them, had won for him a unique place among his neighbors; so that, while he was little known beyond the borders of his own county, he there easily took first rank among the most respected and honored citizens.

What seemed the close of a career was only its beginning. He had not yet erected a monument; he had simply laid the foundation, broad and deep and secure, as a pedestal on which the finished statue of his career was to stand. In 1854 the Representative from his Congressional district declined a reelection, and Mr. Morrill was brought forward as a candidate by his neighbors of Orange County. He was, as I have said, practically unknown to the district. His immediate predecessors had been among the ablest and most eminent public men of a State whose annals are crowded with great names, one of them being that of Jacob Collamer, who afterwards represented Vermont in the United States Senate, and who has been selected to stand side by side with Ethan Allen as a representative of Vermont in Statuary Hall at Washington. It is not surprising that other counties of the district should have looked with some distrust upon this new man, and that a bolting candidate in his own party should draw off a considerable number of votes (2,473). This, at a time when political parties were somewhat more evenly divided in Vermont than in recent years, proved to be a serious matter, and Mr. Morrill was elected by a majority of only 59 votes. It is startling to think what momentous possibilities were carried by those 59 votes. The laws of Vermont then required a majority of all votes cast to elect, and a change of only 30 votes out of 16,701 in a rural Congressional district, removed almost outside of the great currents of public life and opinion, might not only have changed forever the career of a single man, but, as we now see, would have checked or turned aside a great stream of constructive influences, the importance and efficiency of which is altogether impossible to compute. I am not of those who would attach too great importance to the influence of single minds. There is a half truth in the saying of Emerson to the effect that the history of the world resolves itself into the biographies of a few strong characters; but that is largely, as I think, because such characters represent and interpret rather than create the periods in which they live. The greater truth is that expressed by Tennyson:

> "Yet I doubt not through the ages one increasing purpose runs,
> And the thoughts of men are widened with the process of the suns."

The great streams of human destiny flow on, not ordered by a blind fate, but by that great constructive Intelligence which rules from everlasting to everlasting. In one view a man or a race seems but of slight account in the midst of these irresistible, all-compelling, cosmic forces. But, on the other hand, they often color the stream or change its direction, and, while each group or race must be swept on by forces mightier than itself, it is also true that each is so organized within itself that its final

contribution to the sum total of human progress is largely summed up and expressed in some one generation or individual. As Lowell says:

"All thoughts that mould the age begin
Deep down within the primitive soul,
And from the many slowly upward win
To one who grasps the whole."

That "one" may be a Julius Cæsar, or a Charlemagne, or a Frederick the Great, or a Hildebrand, or a Savonarola, or a Luther, or a Cromwell, or a Washington, or a Lincoln. Every such man is the embodiment and representative of the life of his era, and the loss or misplacement of that one may involve, therefore, the loss or misplacement of a whole historical epoch. Mr. Morrill, in his measure, was such a man.

In December, 1855, he began what proved to be the longest and, as I am inclined to believe, one of the most fruitful legislative careers thus far recorded in our Congressional history. Certain it is that most of the important legislation of Congress during his long service felt the impress of Mr. Morrill's mind, and much of it took its final form under the influence of his judgment. The bolting candidate of 1854 never reappeared, and had no successor. Mr. Morrill was sent to the House for a period of twelve successive years, with majorities ranging from 6,573 to 9,337, and then, in 1867, transferred to the Senate, where he served continuously thirty-two years, making an unbroken record of forty-four years, on the shining rolls of which there is no mar or stain. I venture to say that no man ever approached him or, after looking into that noble face, thought him approachable with a proposal to do an act that was not scrupulously honorable. During the course of this long career Mr. Morrill is said to have made not less than one hundred set speeches, and, according to a statement which Dr. True, of the Office of Experiment Stations, was kind enough to have prepared for me, his name appears in the record of proceedings no fewer than 2,477 times as introducing bills, petitions, and resolutions, making remarks or speeches on pending questions, and intervening with suggestions or motions for the orderly conduct of business. He early showed a remarkable aptitude for the details of parliamentary procedure, and was soon recognized as peculiarly fitted to report important measures and take charge of them on the floor of the House. The clearness and simplicity of his expositions, his remarkable grasp of details, as well as of broad, general principles, and his unfailing courtesy toward opponents, coupled with unyielding firmness in maintaining the rights of himself or his committee, made him remarkably successful in guiding a piece of projected legislation through the confused tangle of a running debate. Although he spoke so frequently, he is seldom if ever found repeating himself, and the range of subjects to which he gave intelligent attention, and to the discussion of which he contributed either opinions or facts, fills one with constant surprise. The wonder is how any man could speak so frequently in the course of running debates and on so wide a range of topics without dropping into the merest commonplace.

In the second session of the Thirty-seventh Congress, for instance, in which he introduced his second land-grant bill, he is recorded as having made remarks on the appointment of collectors of the income tax, on the payment of bounty to soldiers, on tea and sugar duties, on the direct tax, on the Post-Office appropriation bill, on the diplomatic bill, the homestead bill, the fortification bill, the Treasury note bill and the tariff bill, on the Illinois Ship Canal, the financial policy of the Government, the naval appropriation bill, the claims for losses by the rebellion, on printing the Patent Office Report, on confiscation, on the volunteers' bounty bill, on a case of alleged drunkenness in the Army, on the Pacific Railroad bill, the army deficiency bill, the tax bill, the army appropriation bill, the newspaper postage bill, the legislative bill, the civil bill, and on the donation of land for a navy-yard. In addition to this he made a set speech in opposition to the Treasury note bill, and presented amendments to the antipoligamy bill, which he was the first to introduce into Congress.

There could be no more striking evidence of the breadth and versatility and accuracy of his knowledge, as well as the steadiness and alertness of his mental processes. His mind seemed to work with the regularity and ease of a finely organized machine, the motive power of which was a well-considered and tenacious purpose. He gave to his duties the same clear and placid intelligence, the same alertness of mind, the same absolute integrity, the same consideration for the opinions and prejudices of others, the same knowledge of the deeper forces of human nature, and the same high ideals that had shaped his earlier career; and all these qualities were enlarged and illumined in the light of a wider range of vision which his higher position gave. In the committee room, on the floor of either House, in his intercourse with his fellow-members, in his relations to the great departments of the Government, in his constant

cultivation of the gentle amenities of social and friendly intercourse, he knew but one thing—to obey the dictates of his own crystal conscience and to serve his fellow-men. Horace foresaw him: "Integer vitae, scelerisque purus." He was one of those finely balanced characters that almost elude analysis. His excellences were so uniformly diffused through the whole man that no one seemed especially to predominate. He was equally the philosopher and the man of action. Holding his own deep religious convictions with quiet but unwavering firmness, he had no word or thought of uncharitableness for those who held other views. A strong and uncompromising party man on general principles, he did not hesitate to speak and vote against his party when he believed it to be in the wrong. Mere majorities had no meaning for him, except as they accorded with his own convictions of truth and duty. Without a trace of asceticism, he always gave the impression of one who walked by an inner light and drew the inspiration of his life from unseen and immortal springs. He was a man among men; in the world, but not of it.

Aside from the comparatively fleeting memory of his fine personality, his permanent fame will be identified with three great measures, or groups of measures, either one of which would have been sufficient to give him a lasting place among the constructive statesmen of the Republic. These measures are:

1. The tariff law of 1861, with its later modifications, and the complementary system of internal revenue.
2. Measures for the construction or modification of public buildings.
3. The land-grant act of 1862 for educational purposes, and the later supplementary legislation.

No account of the tariff act of 1861 would be adequate without a general review of the financial and industrial condition of the country during the previous twelve or fifteen years, as affected by the tariff acts of 1846 and 1857, the discoveries of gold in California and Australia, the movement of population that immediately set in toward the gold fields, the filling up of the West, partly occasioning and partly occasioned by the Kansas-Nebraska legislation of 1854 and subsequently, and the great financial crash of 1857, following which the credit of the United States was so low that the Government was compelled to sell a 6 per cent gold bond at 89.1 cents on the dollar. It should be added, however, that this great depression of credit was partly occasioned by the political disturbances preceding and following the Presidental election of 1860, since the permanent debt of the United States (at that time $45,000,000, bearing 5 per cent interest) stood at a premium of 3 per cent in the market.

Mr. Morrill's first tariff measure had for its object to strengthen the credit of the Government, to provide for the payment of a floating debt in the form of outstanding Treasury notes, and to raise the amount of revenue required for the ordinary needs of the Government and for the payment of interest on its bonded debt. The emergency was so pressing and so generally recognized that the measure passed both Houses and was signed by President Buchanan only two days before the close of his administration. This tariff act was drawn on distinctively protective lines, and introduced for the first time into our tariff legislation the principle of applying specific and ad valorem duties, in certain cases, to the same articles, thereby creating, on the one hand, a partial set-off against possible undervaluation, and avoiding, on the other hand, the injustice of placing the same amount of tax on different grades of articles of the same name.

Whatever academic objection may be raised against the system of which Mr. Morrill thus became the sponsor, and whatever practical defects may be from time to time discovered in its working, it is only a bare statement of fact to say that it has on the whole been sustained by the judgment of the country as represented in Congress during the forty years that have followed it—with the single brief break made by the Wilson measure (1893–1897)—and has accomplished far more than its most sanguine friends anticipated. This measure, with its subsequent modifications, was the backbone of a financial system which enabled the Government to carry on the most costly and destructive war of modern times, and, after the extraordinary expenses of the war had ceased, provided means for paying off $100,000,000 of debt per annum for several successive years; so strengthened the public credit that bonds of the United States bearing only 2 and 3 per cent interest now stand at a premium in the market; increased the wealth of the country from $16,000,000,000, in 1860, to $90,000,000,000, in 1900; made us, in addition to being the greatest agricultural nation in the world, the greatest manufacturing nation, increasing our annual exports of manufactured products from a few millions to nearly five hundred millions; enabled us to equip European railways with American locomotives, to build battle ships for Russia and underground electric railways for London, to erect steel bridges in Central Africa, to lay down steel rails in Russia, Australia, and Java, and to take up Government loans for Germany, Russia, and Great Britain. It is a system under

which the center of gravity of the financial world seems slowly but surely shifting from London to New York, to rest at last in Chicago or San Francisco. These are the stupendous and controlling facts. Mr. Morrill neither devised nor foresaw the whole, and it would be idle folly to attribute these results wholly to the legislation that he promoted, or to any other single cause; but one of his enduring memorials will be the fact that the line of financial policy with which his name is identified has proved to be in accord with the direction of political and industrial evolution, and that his fundamental conception in the tariff act of 1861 has remained undisturbed as the corner stone of all our subsequent revenue legislation. And, even if all that is alleged in criticism of the financial policy of the Government from 1860 to 1900 should be admitted, it must still be recognized that that is a wonderful system which could stand the strain and weakness of so great alleged defects and yet produce such marvelous and almost magical results. This is not the time or the place to discuss that system or the correlated system of internal revenue. I merely note it as one of the great things from which Mr. Morrill's name and fame can never be separated.

His connection with the adornment of the National Capital with great and worthy public buildings is no less direct, and, in some ways, quite as important as with those things which have just been mentioned. He was a prime mover in the completion of the Washington Monument, after more than a quarter of a century of neglect; in the erection of the stately and commodious buildings in which are housed the State, Navy, and War Departments; in the practical reconstruction of the Capitol building by a system of marble terracing which has restored the west front to something like artistic proportions;[1] in having the old Hall of the House of Representatives set apart as a Statuary Hall, in which are gradually gathering, as the choice of the several States may dictate, the bronze and marble forms of those who have dared and suffered and achieved for the Republic, and whose silent lips will ever speak to the youth of the land lessons of loyalty, and courage, and patriotism, and faith, and hope. But above and beyond all these, worthy as they were and are, must be ranked his precious contribution to the land he loved in the erection of a noble and beautiful home for the Congressional Library. It is a strange thing that a man, born and reared amid the simplest surroundings, who had probably never seen an important work of art until he had reached the age of middle manhood, should have had so distilled into his soul, by the contemplation of nature and by his silent communion with the best and greatest thought of the world as embalmed in the noblest literature, that fine artistic sense which led him to idealize the Republic, and then to strive to have that ideal realized in enduring architecture. To his thinking, nothing was too good, or noble, or refined, or beautiful to represent the best impulses and aspirations of that great democracy whose heart he knew, whose language he spoke, and in whose future he had an immeasurable faith.

It was a fitting climax to all this that his very last speech in the Senate should have been a plea for the erection, on the square facing that where the Congressional Library stands, of a building that should be in like manner the home of the Supreme Court of the United States, and in keeping with the serene and lofty part which that matchless institution plays as the balance wheel of our great political system.

But great and far-reaching as were the measures already named, it seems certain from our present point of view that Mr. Morrill's largest fame will forever be identified with the measures which he devised and carried to a successful issue for the establishment and maintenance of a great system of institutions of higher education, to be aided by the United States, organized and controlled by the individual States, and fitted in as an integral part of the whole scheme of public instruction. To a subject which has been discussed so much and from so many points of view, I can hope to contribute very little that is new, and it covers so wide a field, both theoretical and practical, that the present occasion permits only a bare outline of suggestion on the most salient points.

The law which now stands on the statute books of the United States was approved by Abraham Lincoln on the 2d day of July, 1862. That act of the President was the culmination of a struggle which had been actively maintained by Mr. Morrill for nearly five years. He introduced his first bill in the House of Representatives on the 14th of December, 1857, just at the beginning of his second term in Congress. The bill was held under consideration by the committee for a period of four months,

[1] Unless my memory is entirely at fault, Mr. Morrill stated to me while the work was in progress that the conception and design of the marble terracing were to be credited to Mr. Frederick Law Olmsted, but Mr. Morrill was in a position where he could accept or reject the design, and was no less, of course, the sponsor for it before Congress.

and on the 15th of April, 1858, was reported to the House with an unfavorable recommendation, accompanied with majority and minority reports setting forth the respective grounds of opposition and of support. Five days later Mr. Morrill took the floor in support of the bill. His argument was based upon the broadest grounds of public policy, maintaining that the public lands, being a common fund for the benefit of all parts of the country, should be so utilized as to promote the welfare of all sections in due proportion; that Congress had used a portion of the first public lands that came under its control in the Northwest Territory for the promotion of primary and university education, and had repeated similar legislation in favor of every State afterwards admitted to the Union; that this policy was too well established to admit of opposition on constitutional grounds, and that no legislation could more directly advance the interests of the great masses of the people than by providing means for bringing the new discoveries of science to the aid of agriculture and the other industries of life. His speech was earnest, elevated, persuasive, and weighty, and though his views were strongly antagonized at every point, in a House in which he and his party were in the minority he succeeded at last in securing the passage of the bill (April 20, 1858), by the narrow margin of 105 to 100 votes.

An attempt was made to bring up the bill in the Senate at the beginning of the following session, but the antagonism was so powerful and determined that the measure was held back until the 1st of February, 1859. An uncompromising opposition to its passage was led by Senators Pugh, of Ohio; Clay, of Alabama; Jefferson Davis, of Mississippi; Rice, of Minnesota, and Mason, of Virginia—an array, at that time, of powerful names. The last-named Senator denounced it as the attempt to inaugurate a new policy; as "one of the most extraordinary engines of mischief" that he could conceive as originating in the Senate; as a "visionary project" unworthy of notice. Clay, of Alabama, characterized it as "one of the most monstrous, iniquitous, and dangerous measures which had ever been submitted to Congress;" as a delusive attempt to do an impracticable, if not an impossible thing. But his principal opposition was based upon the argument that the bill was a direct violation of the rights of the States and an attempt to secure control of their most important interests through the agency of an educational system. Now, even after this short interval of years, his language has a musty flavor of antiquity. Let me quote a single brief passage: "The Federal Government," he said, "is the creature of the States and is dependent upon them for its organization and operation. All its powers are subordinate to the States from whom they are derived. The States are in no wise dependent on the Federal Government for their operation, organization, support, or maintenance. I stand as an ambassador from a sovereign State, no more subject to the control of the Federal Government, except in a few instances provided in the Constitution, than any foreign and independent State. This bill treats the States as agents instead of principals, as creatures instead of creators, and proposes to give them their own property and direct them how to use it"—and much more to the same effect. Senator Davis, of Mississippi, confined his attention almost wholly to the constitutional argument, at the same time declaring that the proposed legislation was unnecessary and could produce no good results. Senator Rice, of Minnesota, said that he "looked upon the success of this measure as bringing a slow, lingering death to Minnesota." Senator Wade, of Ohio, was its principal champion; and, after every expedient of opposition and delay and denunciation had been exhausted, the bill was finally passed (February 2, 1859), with some amendments, by the narrow margin of three votes—the vote standing 25 to 22. The House promptly concurred in the amendments and the bill was transmitted to President Buchanan, who vetoed it February 16, 1859, on the two fold ground that the Government was too poor to make the proposed donation, and that the bill was unconstitutional.

There is no evidence, so far as I have seen, that the failure of this first attempt was to Mr. Morrill a source of discouragement or hesitation. He saw, of course, that it would be useless, even if it were possible, to secure the passage of the bill a second time during President Buchanan's term, and accordingly he made no attempt, so far as I am aware, to introduce it during the following Congress (March 4, 1859, to March 4, 1861), but on December 16, 1861, directly after the assembling of the first regular session of the new Congress, he introduced the bill a second time in the House of Representatives.

In the meantime great events had been happening. When the first bill was introduced the country was in a state of profound peace, except that political antagonism had become sharply defined, and thoughtful men everywhere beheld the portents of a coming struggle for political supremacy between the North and the South, though very few looked for physical violence, much less war. When the second bill was

introduced war was in actual progress. The Southern States had passed ordinances of secession, formed a Confederacy with the final assent of an overwhelming majority of the people of the seceding States, taken possession of nearly all United States property within their limits, organized a strong central government, placed armies in the field, and won repeated successes in their encounters with the army of the United States. The South expected, a great part of Europe believed, and many in the North feared that the Confederacy would succeed in establishing its own independence on the ruins of a shattered Union. A special session of Congress during the summer of 1861 had provided men and money for the maintenance of the Union, and when Congress assembled in regular session in December the minds of men were filled with nothing but the pending struggle and the means of bringing it to a successful issue. It is highly characteristic of the sobriety and patience and tenacity and serenity of Mr. Morrill's intellectual processes that at such a time he should turn aside from the consideration of measures relating to the prosecution of the war and calmly perfect his great measure for the promotion of popular education. It was also an act of faith and a prophecy. To his mind there was no doubt about the issue of the struggle, and even if his confidence in the perpetuity of the Union should finally prove mistaken, he still knew that no measure could more surely repair the ravages of war and safeguard the future than the one which had for so much and for so long a time absorbed his thought. It may be inferred, however, from the meager notices in the Congressional Globe, that Mr. Morrill found it impracticable, amid so many other matters of urgent and instant necessity, to secure time for the consideration of his bill in the House, for on the 2d of May, 1862 (nearly five months later), the same bill was introduced in the Senate by Senator Wade, of Ohio. The opposition in the Senate to the second bill, was determined but unsuccessful. Senator Lane, of Kansas, declared that the measure would be "ruinous to Kansas," and that a more iniquitous bill had never been introduced in Congress. But after all discussion it finally passed the Senate (June 10) by a vote of 32 to 7. In the meantime (May 29) the House bill had been reported negatively from the Committee on Public Lands, and on June 5 Mr. Morrill had unsuccessfully asked leave to introduce a substitute bill, but the Senate bill, having been transmitted to the House, was taken up (June 17) and passed by a vote of 90 to 25, after several attempts at amendment and delay had been voted down. Otherwise than this there was not a word of debate on the measure in the House. Mr. Morrill simply remarked that the measure was well understood, having been before Congress and the country for five years, and he bore himself throughout as one who was sure not only of himself but of his support by the House.

One of the most striking facts that appears in connection with the discussion of the two bills in both House and Senate, is that scarcely anyone except the author of the bill showed any clear understanding of its real scope and meaning. Many of those who opposed the measure did so on alleged grounds which were plainly contradicted by the language of the bill itself, while those who spoke in support of it confined themselves almost entirely to correcting such misstatements. Nothing could better show how new was the field into which Mr. Morrill was urging Congress to enter than the course of these discussions. It is easy for us, at a distance of forty years and with full knowledge of the revolution that has during that time taken place in the whole spirit and method of higher education, to look back with something of amusement and surprise at the crudeness of opinion then displayed; but it should be borne in mind that both the direction of Congressional legislation proposed by Mr. Morrill and the theory of education involved in his bill were new not only to Congress, but to the country at large. There were then in the United States less than half a dozen institutions, outside of West Point and Annapolis, where young men could obtain advanced instruction in civil engineering, while electrical engineering was absolutely unknown, and mechanical and mining engineering were taught only through a course of practical apprenticeship. The whole field of physics had hardly been touched except on the theoretical side, and such a thing as a physical laboratory did not then, I believe, exist in the United States. With respect to the natural sciences the case was hardly different. A few eminent names like Silliman, in chemistry; Dana and Hitchcock, in geology; Gray, in botany; Agassiz, in zoology, had created interest in those particular subjects, but there was not an institution in the country, even those with which these distinguished scholars were connected, in which these subjects were not relegated to a minor and comparatively incidental position. Even Agassiz, when in 1848 he accepted an appointment in Harvard College, took the two chairs of zoology and geology.

Two powerful influences were working for a change. The first was the fact that scientific inquiry was beginning to reveal to the world its marvelous possibilities, and the other was a kind of blind, groping instinct in the popular mind leading to the

conviction that scientific knowledge ought in some way to be made more useful to the daily occupations of life than had previously been thought possible, and that the educational system of the country ought to contribute more directly to that end than it was then doing. Dr. True has published a very interesting account of several early attempts to work out this idea, and Mr. Morrill was in close communication with men who had caught the impulse of it. But neither colleges nor teachers nor appliances nor methods of instruction were ready for this new demand. It is interesting to note that the great measure of relief provided by Congress was devised by a man who had had no advantages of collegiate or other higher education, and thus was free from the narrowness and prejudices which such an education sometimes produces, while on the other hand he was both by sympathy and by training a man of the people, thinking their thoughts, moved by their emotions, and putting into clear and effective speech what they dimly and vaguely felt.

Aside from the administrative provisions of his bill, the often quoted words which declared its controlling purpose were practical enough to answer immediate needs, novel enough to open a tempting field of educational activity, and broad enough to cover the widest possible range of future growth. Mr. Morrill once assured me, in answer to an inquiry, that the language was his own, and familiar as it is I may be permitted to quote it here.

After providing for the investment of the proceeds of the sales of the lands, section 4 of the act declares that the money so invested "shall constitute a perpetual fund," that this fund shall remain "forever undiminished," that the interest on this fund shall be "inviolably appropriated, by each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

Agriculture was then almost the only great industry of the country, and not unnaturally the Congressional mind and the popular mind caught first at the idea of "agricultural" colleges and "agricultural" education as the subjects chiefly contemplated by the bill; but Senator Morrill himself, on repeated occasions, public and private, stated the true intent and object of the law in language that leaves no room for doubt or question. At one time he said:

"It is perhaps needless to say that these colleges were not established or endowed for the sole purpose of teaching agriculture. Their object was to give an opportunity for those engaged in industrial pursuits to obtain some knowledge of the practical sciences related to agriculture and the mechanic arts; such as they could not then obtain at most of our institutions called classical colleges, where the languages, Greek and Latin, French and German, absorbed perhaps two-thirds of all the time of the students while in college.

"But it never was intended to force the boys of farmers going into these institutions so to study that they should all come out farmers. It was merely intended to give them an opportunity to do so, and to do so with advantage if they saw fit.

"Obviously, not manual but intellectual instruction was the paramount object. It was not provided that agricultural labor in the field should be practically taught any more than the mechanical trade of a carpenter or blacksmith should be taught. Secondly, it was a liberal education that was proposed. Classical studies were not to be excluded, and, therefore, must be included. The act of 1862 proposed a system of broad education by colleges, not limited to a superficial and dwarfed training such as might be had at an industrial school, nor a mere manual training such as might be supplied by a foreman of a workshop or by a foreman of an experimental farm. If any would have only a school with equal scraps of labor and of instruction, or something other than a college, they would not obey the national law. Experience in manual labor, in the handling of tools and implements, is not to be disparaged; in the proper time and place it is most essential, and generally something of this may be obtained either before or after the college term, but should not largely interfere with the precious time required for a definite amount of scientific and literary culture, which all earnest students are apt to find far too limited."

So clear was Mr. Morrill's view on this point that in the title of the bill that he introduced December 15, 1873, he called the institutions "national colleges for the advancement of general scientific and industrial education," and he used to say that the name "agricultural colleges" would never have been applied to the institutions except that it had happened to suit the casual convenience of an index clerk.

At the risk of repeating what is already familiar, permit me to call attention to the cumulative marshaling of thought in the portion of the law just quoted. Each State

is required to bind itself to maintain at least one "college," a term at that time applied to a well-known type of institution which provided a four-years course of liberal education in certain well-defined groups of studies. In keeping with this fundamental idea the new colleges were to make it their "leading object" to teach "branches of learning," and, more specifically, such branches "as are related to agriculture and the mechanic arts." If the language of the law had stopped at that point it would have been sufficient to cover all that has since been done or can in the future be done by the institutions thereby established; for, what branches of learning can be conceived which are not "related" to agriculture and the mechanic arts? Certainly every branch of mathematical, physical, and natural science is directly so related, and there is not another branch of science known to man which is not in turn related to, and in most cases essential to, the mastery of the great fields of experimental science. But if the language of the enactment had stopped at that point it would have fallen far short of the author's intent, and would have been liable to the misconception of providing only for theoretical instruction in the branches of knowledge named, in the same manner as the then existing colleges were chiefly doing. Accordingly, these "branches of learning" are to be taught in such a manner as to promote a "practical" as well as a liberal education.

It was the emphasis laid upon the practical element in education which gave its distinctive character to Mr. Morrill's plan; and this education, at once "liberal" and "practical," was to be provided for the "industrial classes"—meaning by that not to suggest a gradation of rank or classes among the great body of the people, but merely to designate all those who were engaged in pursuits other than such as alone were then called professional, viz, law, medicine, and theology. But even this did not fill the measure of Mr. Morrill's thought. He did not aim to restrict the non-professional classes (as just defined) to a single field of learning or to subject them to a single form or type of education. Other scientific studies than those related to agriculture and the mechanic arts were not to be excluded, the ancient classics were not to be excluded, and the new colleges were so to cover the whole field of ancient and modern learning as to fit their students for "the several pursuits and professions in life." Mr. Morrill's purpose was, in short, to bring all the resources of modern science into direct relation to modern industries, and to emancipate aspiring and talented youth from the necessity of patronizing only one type of college and entering only one restricted class of professions. This "practical" aim was a definite foreshadowing of what is now known as the laboratory method, which is coming to be everywhere recognized as absolutely indispensable to the best teaching of every branch of science, whether pure or applied, and to the widespread establishment of which the land-grant colleges have powerfully contributed.

It may well be doubted whether the States that accepted the Congressional grant had any well-defined conception of what it meant. On its face it was merely a contribution toward the establishment of a kind of college of which the need was already widely felt; but it was, in fact and in its consequences, much more than that. Every State accepted the grant on the conditions specified by Congress, and, in doing so, entered into a contract obligation with the United States to make a college a part of its system of public education. I find no evidence that even Mr. Morrill perceived the full significance of this fact; but the movement was in reality, though unconsciously, the most important step yet taken toward the realization of that great idea which Jefferson had conceived and to which he devoted many years of his life—of a school system in every State, beginning with the primary schools and reaching by regular gradations up to a State university, and through the State universities to a national university—all to be nonsectarian, scientific in aim and method, and supported by public taxation.

The success of the new institutions was not everywhere equal, nor was it secured in any State without a struggle. They were, in fact, entering a field of education that was practically a terra incognita. They were required to teach the leading branches of experimental science, natural and physical, without proper buildings, equipment, or apparatus, and, above all, without the possibility of obtaining in the United States, at that time, men enough properly trained to fill the newly established chairs. President Gilman, of Johns Hopkins, then a professor in Yale College, pointed out, in an article in the North American Review, that one of the most serious obstacles to these institutions at the outset would be found in the lack of trained teachers, a lack which, happily, no longer exists and which the institutions themselves have done much to supply. Another obstacle came from the antagonism of colleges and so-called universities already established; and their antagonism, supported by a powerful body of opinion, forced upon the public mind a consideration of the whole question of the proper function of the government, whether national or State, in respect to the support of higher education. It would probably be too much to say

that the question has yet received a final settlement, but there is abundant evidence furnished by the growth of these institutions and the support given to them by the public that the question is well on the way toward solution, and in the direction outlined by Jefferson and successfully entered upon by Morrill.

Public education at public cost is not maintained for the sake of the individual, but for the sake of the State, the collective whole. If it is true, as Washington said, that "in proportion as the institutions of government reflect public opinion it is essential that that opinion be educated," it is also true that the education must vary in accordance with varying conditions of public life and the changing evolution of public institutions. When the business of government was simple and confined to but few objects an elementary education may have been sufficient to prepare the masses of men for the intelligent discharge of the duties of citizenship; but when that business becomes highly complex, as in our own time, and has to deal not only with the greatest national interests but with matters of world-wide concern, then it becomes indispensable to the welfare of the State that the highest attainable education shall be placed within the reach of every youth who has the ambition, the energy, and the intellectual ability to acquire it. Mr. Morrill and the generation that accepted his plan builded better than they knew, and in their action I see the sure instinct of a great democracy working out the highest law of self-preservation. The opposition to these new institutions was, in fact, based on the same theory and supported by the same arguments as have been used in almost every State against the establishment of common schools at public expense, against county superintendencies, against normal schools and high schools, against central control, and against every other proposed scheme for improving them; but the cause of public education in all its branches has steadily advanced in spite of every form of opposition, and the public mind has at last fairly grasped the principle that there is no logical stopping place between a public support of elementary education and a public support of the highest university education.

Mr. Morrill never lost his active interest in the welfare of the institutions that had been founded by his instrumentality, and members of this Association who remember his appearance before it at one session of its last convention in Washington will never forget the mingled pride and diffidence with which he expressed his gratification in what these institutions had done and were doing and promised to do, and especially the touching note of personal affection with which he greeted the members as they thronged around him to grasp his hand. He was profoundly and unaffectedly happy in the visible fruits of his accomplished work, far surpassing, as he said, his fondest hopes.

It would be an interesting task, but one requiring more leisure than I have been able to command, to follow out step by step the evidences of his watchful care over their interests after they were once established. During the winter of 1872–73 the present distinguished senior Senator from Massachusetts, then a member of the House, was very earnestly engaged in pushing a measure for the establishment of a permanent educational fund from the proceeds of the sales of the public lands, which should be applied directly to the maintenance of public schools throughout the United States—the distribution to be made partly on the basis of illiteracy and partly on the basis of population. Senator Morrill at the same time had equally at heart the establishment of a permanent educational fund from the same source, the proceeds of which should be applied to the further maintenance of the land-grant colleges of 1862. The antagonism between these two measures, each proposing for the time being to absorb the entire proceeds of the sale of public lands, was finally reconciled by an agreement between the supporters of each to appropriate one-half of such proceeds to each of the objects named, and the two bills were modified accordingly, a limit of $50,000 a year for each State being placed upon the amount of the college income, the common-school fund remaining indefinite. The two bills, as thus modified, had the active support of a very large majority in each House, but were opposed with great earnestness by some of the ablest Senators then in Congress, and both failed of final passage through the inaction of a committee of conference which had been appointed to reconcile the differences between the two Houses.

In December, 1873, Senator Morrill introduced a bill (prepared by others, but entirely acceptable to himself) which combined the essential features of the two bills just named; but he did not find the conditions favorable for pressing it to a passage. Mr. Hoar, in the meantime, had reintroduced his bill in the House, and on the 2d day of February, 1874, the House, on the motion of Mr. James Monroe, then a professor in Oberlin College and a member of the House, adopted a resolution instructing the Committee on Education and Labor "to inquire into the condition and management of the agricultural and other colleges which have received grants from the United States under the act of July 2, 1862." Mr. Monroe had been an earnest oppo-

nent of the college bill in the previous session, and this movement was looked upon by the friends of the colleges as distinctly hostile, or, at best, as intended to delay any legislation in their behalf. The committee prepared and sent to all the colleges a long list of questions covering every possible phase of their work and history, and many of them impossible of a definite answer for the reason that they seemed to assume a like condition of things in every State, or at least varying conditions that could be reduced to the same statistical standard. It was agreed among the colleges, however, through some correspondence, that all should make the fullest and frankest answers that were possible under the circumstances, and this was finally done by all except two—Kansas and Florida.

On the 13th of January, 1875, Mr. Monroe presented the report of the committee (Report No. 57, Forty-third Congress, second session).

The report avowedly refrains from discussing all questions of general policy involved in the establishment of these institutions, and expresses gratification at the desire shown by most of them, not only to furnish the facts sought for, but to aid the committee by suggestions as to the best method of accomplishing its object. It then proceeds to summarize the facts ascertained respecting the sale of lands and land scrip, the investment of the proceeds in the several States, the financial management of the fund, the amount of income from it, and the educational results. The institutions themselves are described as being "in a state of formation," some States having not yet made provision for the establishment of colleges, and others but recently—only six in all having been in operation prior to 1865. The report concludes, therefore, that it was then "too early to obtain intelligent answers" to the questions asked, and adds that, while "there is nothing in the results thus far attained that can be called discouraging, * * * a considerable number of the colleges have done work which requires no apology, and a few of those earliest organized have already found time to take high rank among the institutions of the land."

"It must be added," continues the report, "that the reports sent from these colleges reveal, in many cases, a certain fresh interest and spirit of youth, a new enthusiasm, which when intelligent and enduring is one of the best prophecies of success. Strong evidence is afforded of the power of these institutions to establish sympathetic relations between themselves and the communities in which they are placed, in the fact that they have already received in appropriations from States and in donations from towns, counties, and private individuals an amount almost equal, in the aggregate, to the whole bounty of the Government."

It seemed proper to call attention to this report because it was the first and the last movement in Congress which has ever betrayed the slightest distrust of the work that was being done by these institutions, and it is gratifying to add that Mr. Monroe himself was so convinced by his inquiry that he not only made his report, as we have seen, a strong justification of them and their work, but became and remained ever after one of their steadfast friends.

During the two years next succeeding, political excitement ran so high in Congress and out that Senator Morrill appeared to think it inexpedient to press for any further legislation in behalf of the colleges. He had the subject continually before his mind, made numerous minor modifications of the bill which he had introduced in December, 1873, and there was never a day, I think, when he was not prepared to introduce a bill if there had seemed any prospect of securing time for its consideration. In March, 1877, Senator Sherman having resigned his seat to accept a place in the Cabinet of President Hayes, Senator Morrill succeeded him as chairman of the Finance Committee, and for a time his principal attention was absorbed in that direction. This of itself would probably have prevented him, for the time being, from undertaking further active efforts in behalf of the colleges, but a more controlling reason lay in the fact that Senator Blair, of New Hampshire, who succeeded him as chairman of the Committee on Education, devoted himself with great earnestness and persistence to an attempt to secure a large appropriation for the support of common schools. It was only after this measure had repeatedly failed of passage that Senator Morrill (with Senator Blair's hearty concurrence) took up again his favorite subject and secured the passage of the act of 1890, as supplementary to his original act of 1862. This act is of so recent enactment and operation that it is sufficient merely to refer to it in this connection. It was a fitting culmination of Senator Morrill's work for public education. Its helpful and stimulating influence has been felt in every State, and the equal distribution under it has done much to correct the inequalities of the distribution of land scrip under the act of 1862.[1]

[1] By the act of 1862, 30,000 acres were donated to each State for each Senator and Representative in Congress to which it was entitled. By the act of 1890 each State receives an equal appropriation.

Probably Mr. Morrill's last act in this connection was the introduction (March 17, 1898) of a bill providing that whenever the proceeds of the sales of public lands should be less "than is required by the terms of the act aforesaid (the act of 1890) to be paid to each of the several States, any deficiency shall be paid from any money in the Treasury not otherwise appropriated."

Mr. Morrill did not live to see this bill become a law, but a like provision has since been made by act of Congress, and the institutions which Mr. Morrill established in 1862 are now, in 1900, securely grounded on the inviolable faith of the United States. Few men in public life find their own ideals realized or their best purposes embodied in legislation or in permanent institutions; but Senator Morrill, at the close of his career, could look back upon a great body of noble results as enduring as the Republic.

This outline sketch of Senator Morrill's work would be incomplete without a brief statement respecting the growth and the present status of the land-grant colleges. This topic in itself would furnish abundant material for a crowded hour. At present I must confine myself to the bare mention of a few characteristic facts. It should be borne in mind that the act of 1862 did not directly donate the lands to the States, but offered them to the legislative acceptance of the States on certain clearly specified and stringent conditions. The most significant fact, and probably the most unexpected, is the full and liberal response of State and Territorial governments, and, in some cases, communities and individuals, to the initial action of Congress.

The land granted to the States by the act of 1862 amounted to somewhat more than 10,000,000 acres, which has thus far produced a permanent fund of $10,262,944, with lands still unsold of the estimated value of $4,062,850.30, the entire proceeds being, in round numbers, somewhat over $14,250,000. To this have been added other land-grant funds amounting to $1,441,577.38; other permanent funds, $14,442,194.25; farms and grounds, $5,543,108.91; buildings, $16,274,000.53; apparatus, $1,955,859.21; machinery, $1,373,696.75; libraries, $1,854,942.21; miscellaneous equipment, $1,997,690.07, making a grand total of permanent plant of the value of $58,944,137.61. The additions to the permanent endowment and equipment in 1899 amounted to $2,365,152.43.

On this basis 64 institutions have been established. In 1899 they had a total of 35,956 students, with professors and instructors aggregating 2,893 persons, and with a total income of $5,994,037.61, exclusive of the sums received from the United States for Agricultural Experiment Stations. Of this amount $624,672.88 was received as interest on the land grant of 1862 and $1,120,778.96 under the act of 1890, thus leaving to them an income of $4,248,585.77, or more than two-thirds of the whole, from other sources than grants of the United States. During the single year 1899 the States and Territories appropriated for the maintenance and improvement of the land-grant colleges no less than $2,287,917.98.

These figures furnish most striking and conclusive evidence that the policy of Congress, begun by the act of 1862 and continued by the act of 1890, has met a great public need, and that, instead of encouraging inaction or indifference on the part of the States, it has, on the contrary, stimulated them to a degree of activity far in advance of that of Congress. But this array of material strength tells only the lesser part of their story. In the range and quality of their scholarship, in their combination of the practical and experimental with the theoretical, in their adjustment to the conditions of public education in their several States, in their responsiveness to public needs and the best public opinion, they occupy a distinctive position and are doing a work which has profoundly affected the educational life of the country. I confidently believe that with a charter broad enough to cover the whole range of learning the future of higher education in this country belongs largely to these colleges and to the influences that they have created and must continue to create.

The accomplished work bespeaks the man. As these institutions typify American education, so Mr. Morrill in his person and character typified an almost ideal American citizenship. He represented more than most men in public life those deep and silent forces that are the real strength of the Republic—nay, they are the Republic; they are its only promise and potency of continued existence. They come from the sober thought of men and women who listen to the inner voices of conscience and duty and obey in their lives the sovereign law of rectitude—the steadfast souls who do the daily work of the world, not with a parade of virtue or an air of martyrdom, but with a cheerful courage and patience and faith because they know no other call than the call of duty; because, as Luther said, they "can do no other." They are the men and women who support churches and schools and charities and cherish the sanctities of home. They are the men of affairs who understand that there is no great or permanent or worthy success in business life except as it is built on a foundation of absolute truthfulness and absolute integrity, and that the standards of public integrity and private integrity are the same. They are the citizens whose judgments

remain undisturbed amid the clamorous brawl of self-seeking demagogues and who then turn aside to swell that "silent" vote that often upsets all political calculations. They are the sane and honest masses of the people who have thus far in our history proved equal to every emergency and risen to the full height of every great crisis.

It was the source at once of Mr. Morrill's strength and of his limitations in some directions that in his own person he stood for and typified so much of these characteristics of "the plain people." He was peculiarly happy in the State he represented—a sober, energetic, thrifty people; loyal to their State, their country, and their God; patrons of schools and colleges and churches; quick to recognize merit in their public men and wise to continue them long in the public service—the best type, in short, of a true American citizenship—and Senator Morrill was simply one among them. He was of them in his origin, in his character, in his training, in his cast of mind, in his life-long habits of action; but he was of them at their best, and for that reason his career will, for all coming time, set a standard which every youth may hopefully strive to reach, but which few will surpass. The institutions that he established will live as long as the Republic lives. They will increase in wealth and influence and public favor, but their most precious possession and their perennial source of power over the young manhood and womanhood of America will be found in the example of the life and character of their founder, Justin S. Morrill.

Morning Session, Thursday, November 15, 1900.

The convention was called to order at 9.20 a. m., President Stubbs in the chair.

The report of the committee on cooperative work between the Department of Agriculture and experiment stations was laid before the convention for consideration.

After considerable discussion of matters pertaining to this report, especially the question of the publication of the results of cooperative investigations, participated in by A. C. True, M. Whitney, E. A. Bryan, G. W. Atherton, C. D. Woods, and others, H. P. Armsby, of Pennsylvania, moved that the report be received and the committee continued, with instructions to take into consideration especially the subject of publication, and report to the next convention.

After some further discussion of the question of arrangements for cooperation with individual workers in the stations and in the Department, by G. W. Atherton, of Pennsylvania; E. A. Bryan, of Washington; C. D. Woods, of Maine, and others, it was voted to add the phrase "except under such contracts" after the sentence "arrangements between individual officers in the two institutions are deemed inadvisable." Dr. Armsby's motion then prevailed.

President A. T. Hadley, of Yale University, was introduced and spoke as follows:

Mr. President and Gentlemen: It is an unusual pleasure for me to be here and welcome to this place a body of men such as I see before me. I had hoped to have the pleasure of attending a larger part of your meetings, but unfortunately the corporation of Yale University had the bad taste not only to hold a meeting on Tuesday of this week, but to occupy the whole of the day, and I have since been so busily engaged that it has been impossible for me to come in before. I am sure that the prolonged session of the corporation was not of my seeking. I would have avoided it if I could. I am glad on all grounds to be able to have a share in welcoming you here. I believe that this room meets your necessities, and I can certainly say to you that you are exceedingly welcome to Yale. I am very glad to have this opportunity to extend to you the hospitality of the university and to in some measure try to do justice in view of what you are doing for the country. No words of mine can overestimate the importance of the work in which you are engaged. Of all the departments of education in which we have a common interest, there is none more distinctive and none where we need men for the making of men so fully as here. I feel that I can not contribute very much to your discussion. If this were a financial gathering, I should congratulate you at having your stock stand above par. I shall content myself with ending as I began, with an assurance of hearty welcome to you from Yale, both collectively and from myself personally. I trust that before you leave New Haven I may have a chance of seeing you individually and talking over those problems in which you and I have a common interest. Possibly I might say something on those lines, but I will not take your time to do so now.

The convention took a recess of five minutes to greet President Hadley.

On motion of W. O. Atwater, of Connecticut, the executive committee was authorized to send a greeting to the German experiment stations, the occasion being the twenty-fifth aniversary of the first American station and the fiftieth of the first German station.

A. C. True, for the committee on indexing agricultural literature, reported as follows:

REPORT OF THE COMMITTEE ON INDEXING AGRICULTURAL LITERATURE.

The committee on indexing agricultural literature can only report limited progress during the past year. You will remember that a proposition that we were considering at the last convention was to have this work taken up through the librarian of the Department of Agriculture. In order to do that the librarian must have an addition to the funds at his disposal, and as Congress failed to give him this addition, it has been impracticable for him to take up the special work which the committee had in mind, and which the Association in a general way has approved. We have, however, endeavored to promote this general subject, and the librarian of the Department is much interested in the matter, and has, as very many of you know, recently undertaken the preparation of a card index of the Department publications. The cards are sent out to the stations and to a limited number of librarians through the country. Attention has also been called to another piece of work which has been done by the Department during the past year, and that is the indexing of all the publications relating to the work in animal industry. This is a large book and a work of considerable importance, and I think the Association should feel that efforts in this direction are producing definite results, so far as the Department is concerned, and the committee can go on with its work, if the Association so desires, in the hope of accomplishing more hereafter.

The report of the committee was accepted.

E. A. BRYAN, of Washington. Mr. President, if it is in order, I should like to offer at this time a resolution so that the executive committee may fix the time for its future consideration. The resolution is as follows:

Whereas the experiment stations have profited greatly by the annual visits of a representative of the Office of Experiment Stations, such visits not only unifying the efforts of the stations, but improving the spirit and method of research and being conducive to a more satisfactory expenditure of funds; and

Whereas a like visit to the colleges by the Commissioner of Education or his representative would tend to strengthen and unify the land-grant colleges: Therefore, be it

Resolved, That the executive committee of this Association be directed to consider the expediency of inviting the Secretary of the Interior to make such recommendation to Congress as would result in the annual inspection of the land-grant colleges by the Bureau of Education.

The resolution was referred to the executive committee, which later recommended that it lie on the table for one year. It was so ordered.

W. H. JORDAN, of New York. I desire to offer a resolution.

Resolved, That it is the sense of this convention that the cooperative experiment station exhibit prepared for the Paris Exposition under the auspices of this Association be reproduced at the Pan-American Exposition at Buffalo, with such withdrawals or additions as may be deemed wise by the Office of Experiment Stations.

Referred to the executive committee, which later reported it favorably, and it was adopted.

H. C. White, of Georgia, moved that the executive committee be instructed to endeavor to procure the separate publication, for distribution, of the addresses of President Atherton on Senator Morrill and Director Jordan on the American agricultural experiment stations.

The motion prevailed.

J. L. HILLS, of Vermont. Mr. Chairman, I have a resolution to offer.

Resolved, That in view of the widespread and growing interest in the work of farmers' institutes throughout the country, and the need for the more thorough develop-

ment of this enterprise, this Association believes that Congress should place at the disposal of the Secretary of Agriculture funds which may enable him to extend the work which the Department is doing for the promotion of the general interests of the institutes in the several States and Territories.

Referred to the executive committee, which reported adversely, and no action was taken on the resolution.

W. M. Hayes, of Minnesota. Mr. Chairman, I desire to offer the following resolution:

Resolved, That in view of the increasing cooperation of the Department of Agriculture and the agricultural experiment stations, this Association deems it very important that the Department should be able to secure and retain the services of experienced and efficient men in its higher positions of scientific investigation and administration, and will actively support the Secretary of Agriculture in the effort to adjust the work and compensation of such officers in such manner as will conform to the enlarged business of the Department and promote the highest efficiency of its scientific and administrative operations.

Referred to the executive committee, reported favorably, and adopted.

Professor Hayes also presented the following resolution:

Resolved, That a committee of five be appointed to consider the advisability of bringing about a general conference of all persons interested in plant and animal breeding, and in such problems of nutrition as are related thereto, and, if found advisable, to promote the organization of such a conference.

He said: This resolution grows out of a similar conference which was held in England last year, promoted by the English Horticultural Society. The resolution is drawn to include those who were interested in animal breeding as well as plant breeding. It was suggested by Secretary Wilson that I present a resolution in this form.

Referred to the executive committee, reported favorably, and adopted.

The committee appointed consists of W. M. Hayes, of Minnesota; T. F. Hunt, of Ohio; A. A. Brigham, of Rhode Island; L. H. Bailey, of New York, and H. P. Armsby, of Pennsylvania.

W. O. Thompson, of Ohio. I beg your indulgence for a very brief period in order to make a statement to this convention. The subject of a summer school for agriculture is on the minds of some people in the West, and I wish to present that matter here this morning. It has been discussed on several occasions and at other institutions, but the trustees of the Ohio State University have agreed, and have already passed an appropriation in a modest way, to finance such a school for a period of four or five or six weeks, as may be determined. It is proposed to open the school in 1902. The proposition would be to have a faculty of instruction gathered from the colleges and experiment stations represented in this convention, and then have some person elected as the head of this faculty of instruction. The Ohio State University does not confine it, so far as its present efforts are concerned, to the location at Columbus, but it is our judgment that, after giving the matter an experiment of one year, the experiment itself would discover whether it was desirable to give the school a migratory character and take it from institution to institution, or whether it would be desirable to locate it at some point to be agreed upon after the experiment had been made. This first meeting would be wholly in the nature of an experiment, and we present the matter here not because it has been decided definitely to hold such a school of agriculture, but because it has been decided to see whether there is any demand for such a summer school, and we thought that this convention was the most desirable spot in America to present the matter, and that we could draw out from this convention an expression of views that would indicate to us whether such a school was desirable, and whether, in the judgment of the members of this convention, there was an open field for such an effort. We thought you would approve the idea, and we should be glad to know something of what you think of it. The plan was to provide a school which would furnish to our graduate students

and teachers in agriculture such lines of advanced work for a period of a few weeks as would, in the judgment of the faculty of instruction proposed, be desirable, or such a course as would meet the demands and needs of the occasion. We bring this matter before you in this open way because there has been a little doubt in our minds about it, and we are hopeful of obtaining an expression of your views. We do not give you any details as to the course of instruction, which I presume you would not care to hear or discuss at this time, but simply present a general plan of a summer school of agriculture, and ask whether, in the opinion of the members of this convention, it is desirable to hold such a school. We have assurances of a rather definite sort that, in case the school should take a migratory habit, another institution would be willing to finance it for the second year. If the matter should meet with your approval, and also if, in your opinion, such a school will satisfy a need or a demand, it will be actively pushed. I have not had an opportunity to talk this over with very many of the members of this convention, nor have the others from our university had a similar opportunity, but I think you see now just what is proposed and just what we should like to do if there is any need of it. It was rather proposed to make it an intercollegiate school of agriculture so far as possible. That means that it should interest all of the colleges and experiment stations and private individuals interested in this particular line of work. Not that it should be in any sense whatever a private enterprise, but that it should be broad in its scope.

There is no notion in our minds that the State University should keep this up as a perpetual movement, unless something should develop of the nature that we do not now see. It is simply started on the basis that possibly this convention would see the need of a summer school of agriculture, and if, in the opinion of this convention, it would be wise to make such an attempt, an opportunity would be provided to give the matter a chance to be developed. It is proposed to open the school in 1902, because it was thought it would be a little too soon to try it in 1901. It was thought if we could obtain a favorable sentiment of the members of this Association by the time the next convention met, arrangements could be definitely made, a programme announced, and a course of study set forth, so that a year from now, at the annual convention of the Association, it could be made known definitely what was to be expected in the summer of 1902.

Brief remarks on the subject were made by W. M. Hayes, of Minnesota. For action on this matter see page 93.

C. D. Woods, of Maine, from the committee on nominations, reported as follows: Mr. President, the committee on nominations met and talked over frankly and earnestly the situation in the Association, and had especially in mind in making up their nominations the fact that there was no time in the history of the Association, as it seemed to the committee, when there was so much responsibility imposed upon the executive committee and officers of the Association, especially in the way of matters in Congress, as at the present. The nominations which your committee have decided to present are made mainly from the colleges. It was borne in mind that these matters pertained particularly to the colleges. We thought it was due to the Association to make this brief explanation in submitting our nominations as to why we had selected men largely from the colleges. Your committee advises the election of the following:

President.—A. W. Harris, of Maine.

Vice-presidents.—James K. Patterson, of Kentucky; W. H. Jordan, of New York; R. H. Jesse, of Missouri; L. G. Carpenter, of Colorado; E. A. Bryan, of Washington.

Executive committee.—H. H. Goodell, of Massachusetts; Alexis Cope, of Ohio; George W. Atherton, of Pennsylvania; H. C. White, of Georgia.

Bibliographer.—A. C. True, of Washington, D. C.

Secretary and treasurer.—E. B. Voorhees, of New Jersey.

The report was accepted, and, by vote of the convention, the secretary was instructed to cast a ballot for the officers nominated.

Invitations from places desiring the next convention were presented as follows: Lansing, Mich., by J. L. Snyder; Jackson, Miss., by J. C. Hardy; Maine, by C. D. Woods; New York, by W. H. Jordan.

J. E. Stubbs, of Nevada, presented the report of the committee on revision of the constitution as follows:

REPORT OF THE COMMITTEE ON REVISION OF THE CONSTITUTION.

At the very last hour of the meeting in San Francisco a committee was appointed under the title "Committee on Revision of the Constitution." The committee was made up of J. K. Patterson, of Kentucky; M. H. Buckham, of Vermont; H. H. Goodell, of Massachusetts; W. A. Henry, of Wisconsin, and myself. In connection with the appointment of that committee, certain statements were made which seemed to justify at the time the taking of special action and asking the convention to consider the matter then in order that a report might be made to this convention. The committee met after adjournment and organized by the appointment of J. E. Stubbs, of Nevada, as chairman, and H. H. Goodell, of Massachusetts, as secretary. In order to obtain the minds of the various colleges and stations, a communication was sent out to each, asking for an expression of opinion upon the subject of changes in the constitution. Such suggestions as were offered were collected by the secretary of the committee and sent back to the officers of the different colleges and stations, so that they might have the information brought out by the correspondence. The committee met early in February in the city of Washington by appointment. Secretary Goodell was ill, and Director Henry, of Wisconsin, was not able to be present. That left three members of the committee, President Patterson, President Buckham, and President Stubbs, to consider what action should be taken. The printed report here presented sets forth the changes that were agreed upon. Secretary Goodell gave his assent to the changes, and for this reason the report is signed by the four members. It was understood, however, that when the members of the committee came together at the convention they would take the matter up again in full committee. We were fortunate in having present at New Haven all the members of this committee, including both Secretary Goodell and Director Henry, who were unable to attend the meeting in Washington. The chairman of the committee has been instructed to submit to you the report which is before you as the unanimous work of the committee. Your committee has sought, so far as possible, to adopt only those changes which are suggested after mature consideration, and those only which seemed to be desirable.

SUGGESTED CHANGES IN THE CONSTITUTION OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The present constitution of the association is given below, with the changes suggested by the committee. Words in parentheses are to be omitted and words in *italic* are to be added.

NAME.

This Association shall be called the Association of American Agricultural Colleges and Experiment Stations.

OBJECT.

The object of this Association shall be the consideration and discussion of all questions pertaining to the successful progress and administration of the colleges and stations included in the Association, and to secure to that end mutual cooperation.

MEMBERSHIP.

(1) Every college established under the act of Congress approved July 2, 1862, or receiving the benefits of the act of Congress approved August 30, 1890, *and every department of mechanic arts so established*, and every agricultural experiment station established under State or Congressional authority, the Bureau of Education of the Department of the Interior, the Department of Agriculture, and the Office of Experiment Stations of the last-named Department, shall be eligible to membership in this Association.

(2) Any institution a member of the Association in full standing may send any number of delegates to the meeting of the Association, but one shall be designated to the Association as the regular representative and voting delegate. The same delegate may represent both a college and a station, but shall cast only one vote in general sessions. Other delegates may be designated by any institution to represent it

in specified sections of the Association, but such delegates shall vote only in such sections, and no institution shall be allowed more than one vote in any sectional meeting.

(3) Delegates from other institutions engaged in educational or experimental work in the interest of agriculture or mechanic arts may, by a majority vote, be admitted to conventions of the Association, with all privileges except the right to vote.

(4) In like manner, any person engaged or directly interested in agriculture or mechanic arts who shall attend any convention of this Association may be admitted to similar privileges.

SECTIONS.

(1) The Association shall be organized into sections upon (1) college work; (2) agriculture (and chemistry; (3) horticulture and botany; (4) entomology;) (5) mechanic arts. (The executive committee shall, upon the request of any ten institutions represented in the Association, provide for the organization of provisional sections at any convention.)

(2) Each section shall conduct its own proceedings and shall keep record of the same, (and present a synopsis thereof to the Association at the close of every convention;) and no action of a section, by resolution or otherwise, shall be valid until the same shall have been ratified by the Association in general session.

MEETINGS.

(1) This Association shall hold at least one meeting in every calendar year, to be designated as the annual convention of the Association. Special meetings may be held at other times, upon the call of the executive committee, for purposes to be specified in the call.

(2) The annual convention of the Association shall comprise general sessions and meetings of the sections, and provision shall be made therefor in the programme. (The section meetings may be simultaneous or otherwise, at the discretion of the executive committee, but at least two sections of the Association, to be designated each year by the executive committee, shall present in general session of each convention a portion of the subjects coming before them.)

Unless otherwise determined by vote, the Association will meet in general session in the forenoons and evenings of the convention and the sections in the afternoons.

OFFICERS.

(1) The general officers of this Association shall be a president, five vice-presidents, a bibliographer, and a secretary, who shall also be treasurer. The president, junior ex-president, the secretary, and four persons to be chosen by the Association shall constitute the executive commitee, which shall elect its own chairman.

(2) Officers shall be chosen by ballot at the annual convention of the Association and shall hold office from the close of the convention at which they are elected until their successors shall be chosen.

(3) Each section shall, by ballot, nominate to the Association in general session, for its action, a chairman and secretary for such section.

(4) Any person being an accredited delegate to an annual meeting of the Association, or an officer of an institution which is a member of the Association in full standing at the time of election, shall be eligible to office.

DUTIES OF OFFICERS.

(1) The officers of the Association shall perform the duties which usually devolve upon their respective offices.

(2) The president shall deliver an address at the annual convention before the Association in general session.

(3) (The chairman of each section shall make, at the annual convention, a report to the Association in general session of the progress during the preceding year of the subject or subjects appertaining to his section, and such reports shall not occupy more than twenty minutes each.)

(4) The executive committee shall determine the time and place of the annual convention and other meetings of the Association, and shall, between such conventions and meetings, act for the Association in all matters of business. It shall issue its call for the annual conventions of the Association not less than sixty days before the date on which they are to be held, and for special meetings not less than ten days before such date. It shall be charged with the general arrangements and conduct of all meetings called by it. (It shall designate the two sections to present in general session a portion of the subjects coming before them, and shall give notice

thereof to the chairmen of such sections at least ninety days prior to the annual convention.) It shall provide a well-prepared order of business and a programme of exercises, and shall make a seasonable issue of said programme. Said committee may fill any vacancy in an office or committee of the Association occurring after the adjournment of the annual convention, such appointee to serve until the next annual election.

FINANCES.

At every annual convention the Association, in general session, shall provide for obtaining the funds necessary for its legitimate expenses, and may, by appropriate action, call for contributions upon the several institutions eligible to membership; and no institution shall be entitled to representation or participation in the benefits of the Association unless such institution shall have made the designated contribution for the year previous to that in and for which such question of privilege shall arise(, or shall have said payment remitted by the unanimous vote of the executive committee).

AMENDMENTS.

This constitution may be amended at any regular convention of the Association by a two-thirds vote of the delegates present, if the number constitute a quorum: Provided, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given in the call for the convention. Every such proposition of amendment shall be subject to modification or amendment in the same manner as other propositions, and the final vote on the adoption or rejection shall be taken by yeas and nays of the institutions then and there represented.

RULES OF ORDER.

(1) The executive committee shall be charged with the order of business, subject to special action of the convention and this committee may report at any time.

(2) All business or topics proposed for discussion and all resolutions submitted for consideration of the convention, shall be read and then referred, without debate, to the executive committee, to be assigned positions on the programme.

(3) Speakers invited to open discussion shall be entitled to twenty minutes each.

(4) In general discussions the ten-minute rule shall be enforced.

(5) No speaker shall be recognized a second time on any one subject while any delegate who has not spoken thereon desires to do so.

(6) The hours of meeting and adjournment adopted with the general programme shall be closely observed, unless changed by a two-thirds vote of the delegates present.

(7) The presiding officer shall enforce the parliamentary rules usual in such assemblies and not inconsistent with the foregoing.

JOSEPH E. STUBBS,
JAMES K. PATTERSON,
MATTHEW H. BUCKHAM,
HENRY H. GOODELL,
Committee.

The CHAIRMAN. Gentlemen, you have heard the report of this committee on amending the constitution; what is your pleasure?

T. F. HUNT. May I ask for an explanation of the proposed change under the head of "Membership," which admits the departments of mechanic arts to representation? With what does that coordinate?

J. E. STUBBS. The object of this is to coordinate the department of mechanic arts with the college on all matters.

T. F. HUNT. I have no doubt this committee has given the matter more consideration than I have and that the change is proper, but it does not convey to my mind the proper situation in the use of terms.

G. W. ATHERTON, of Pennsylvania. Mr. President, I wish to make a motion. I must admit myself that I am not fully prepared to discuss this matter, and I do not find any discussion as a matter of record in the proceedings of the last convention. The point I wish to make is this: I wish to move that this report of the committee be postponed for one year, or until the next annual convention, and the reason for my motion is simply this: Last year, at San Francisco, as I understand, a resolution was

adopted appointing a committee consisting of the persons named here to consider a revision of the constitution and report at the next convention. So far that was perfectly legitimate. Then the resolution goes on also to say that the appointment of this committee be accepted by this Association as due notice of any change said committee may recommend. Now, I wish very seriously to call the attention of the convention to the fact that such a resolution is absolutely unauthorized, and is going beyond the powers of the convention under the constitution, and it would introduce a practice which might make confusion at any time. If I can now propose a resolution of that kind, and can then add that the appointment of this committee shall be due notice of any proposed amendment I may make under that guise, it is destroying the whole purpose of the constitution in requiring that notices of amendments shall be given. What is the object of requiring that notice of amendments shall be given? Why, that we may know what we are to act upon when the time comes, and know what effect this is going to have on the organic law of the Association. Now, I have no objection to anything that this committee has done except upon that very point that has just been raised. If after discussion the committee considered that change in representation wise, I shall certainly raise no question about it. Whatever is the wish of the majority I am ready to acquiesce in, but in my judgment it is a most serious matter for us to allow the introduction of a practice which would make it possible at any time to spring upon the convention some recommendation of a committee which had not been fully considered. In my judgment it renders us liable to great confusion at almost any time. Some radical change in the constitution might in that manner be adopted which we should not have an opportunity to consider carefully. If we can do that thing in one case we can do it in another and another, and so, as I say, we destroy the very purpose of the constitution under the guise of a skillful form of evasion. We destroy the very purpose for which notice is required. I am raising this point without consultation with others, and solely for the purpose of having this point discussed. I make that motion without prejudice toward the report of the committee. I move that the report of the committee be postponed until the next annual convention, and that the committee be continued. That does give notice, then, that these amendments are proposed, because the report of the committee itself will be notice to the convention of the proposed amendment. We then shall have the specific thing before us to act upon at that time. A year's delay can do no harm to any important interests, while the other course, in my judgment, is a measure which is fatal to the very organization.

J. K. Patterson, of Kentucky. I move as a substitute for Dr. Atherton's motion that the report of the committee be adopted. I do it for the reason that the members of the convention have had this subject before them for a whole year. Copies of the proposed changes have been transmitted by the secretary, and I suppose that every college in the country and every station in the country has, through its special head or director, been advised of the changes that are proposed. I do not see any use in waiting another year. I do not see the purpose or necessity of so tying the hands of this convention that it shall be unable to make any changes in its constitution for a period of two years. We have had this before us for a year, and now if you vote to postpone it for another year it will be before us for two years. I therefore move that the report be adopted.

The motion was seconded.

A Member. According to the by-laws there can be no change in the constitution without a year's notice.

H. H. Goodell. The section on "amendments" provides how the change shall be made.

G. W. Atherton. I will read that section, with the permission of the Chair: "This constitution may be amended at any regular convention of the Association by a two-thirds vote of the delegates present if the number constitute a quorum,

provided that notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given in the call for the convention. Every such proposition of amendment shall be subject to modification or amendment in the same manner as other propositions, and the final vote on the adoption or rejection shall be taken by yeas and nays of the institutions then and there represented." Now, that has not been complied with.

C. S. Murkland, of New Hampshire. Mr. President, I understand the interpretation of the gentleman from Pennsylvania is that these changes demand a full year's previous notice and that the full text of the proposed changes shall be before the Association. Now, this section says—it simply says that every such proposition shall be subject to modification in the same manner as other propositions. Now, if the full text was before us, and was radically amended and then passed, it seems to me no proper notice could be given under the gentleman's contention. It says that notice of the proposed amendment, together with the full text, shall be given in the call for the convention. It says nothing whatever about a notice being given at the preceding year. Now, it seems to me that whatever be the merits of the proposition of the gentleman from Pennsylvania, that due notice has been given of the proposed amendments. So far as that objection goes, it does not seem to me to hold against the recommendations of the committee. There are some other features of the matter about which I do not care to speak at the present moment, but as to the general question it seems to me that there are no valid reasons why we can not act upon the report of the committee.

G. W. Atherton. I should like to say one word in answer to the suggestion of the gentleman from New Hampshire, for whose judgment about such matters I have a great respect, and who is a very careful observer of the rights and forms of procedure. I would like to ask this question: This amendment reads, "Provided, that notice of any proposed amendment, together with the full text thereof and the name of the mover, shall be given in the call for the convention." Now, the executive committee issues the call for the convention. Now, how are the proposed amendments to be brought to the knowledge of the executive committee authoritatively except by a previous notice, given in a previous convention? It is impossible under our procedure. The executive committee can only arrange a programme that has been provided for it under the rules, or else by specific action. Now, as I understand this section, the proposed amendment under our parliamentary procedure must be proposed in the full body or convention of the organization whose constitution is to be changed. That is the universal law, unless the constitution itself makes a specific provision that the amendments may be proposed in some other form.

C. S. Murkland. I am under great embarrassment in differing with the gentleman who has been our guide and friend for so many years, yet it seems to me I am justified in taking a little different view. I do not say that he is wrong, or that I am right, but it seems to me that in a dispassionate consideration of the question there are at least two views which can be candidly taken. One is that which he has explained, and the other is a little divergent in respect to the notice which is required by the spirit of the constitution under which we are working. That is, what is the specific detailed notice which is required? It says in this section that notice shall be given in the call of the executive committee; now, is it intended that the call shall include the full text of the proposed amendment? It seems obvious to my own mind that the intent is simply that there shall be full notice given by the convention. Now, as to the matter in bringing it before the executive committee, that can be done in the way which was adopted, namely, by bringing the matter before the committee and instructing that committee to see whether the report complied with all the provisions of the constitution.

Now we have before us two motions which are diametrically opposed, and it seems to me that the simple proposition now before us is to vote down the first proposition, and then either vote for or against the proposition to accept before the committee.

J. K. Patterson. I would like to hear the chairman of the executive committee upon the validity of the objection taken. He was present at the meeting held in San Francisco when that subject was presented, and I believe that the question was raised there as to the constitutionality of the procedure proposed, and that he was at first disposed to dissent, but that he afterwards acquiesced in the constitutionality of the procedure. That is my understanding. He was a member of this committee, too. He transmitted the copies of the proposed change to each of the colleges in the country, and then after that the committee met in Washington and he transmitted the amendments that we propose to adopt. I would like to hear him say whether during the year when he was engaged in this correspondence, and in the transmission of these documents to the various colleges, he had any doubt as to the validity of the procedure which was taken. If he had I have no recollection of any protest being made in that direction.

H. H. Goodell. I find in the records of the San Francisco convention simply the resolution, but no account of the debate that followed the introduction of the resolution offered. The point of constitutionality was raised at that time by myself, but Director Emery with respect to the point raised by me begged that it might be waived, on the ground that this would be putting off action for another year. The question of constitutionality was discussed, but direct vote was not taken upon it. I never had any doubt, however, upon its unconstitutionality. When the question came up before of a change in the name in the constitution, if you will remember, the proposed amendment was given a year beforehand, and was published at that convention that such a proposition would be made. I never had any doubt as to the right of the convention to appoint a committee of revision, and after the convention had so voted the committee went ahead to carry out the directions of the convention. The committee acted under that vote and the matter is now with the convention.

A Member. After all that has been said it seems to me we are under obligations to our constitution to keep it inviolate, and I think we should continue these propositions for another year, especially in view of the fact that the amendments reported by the committee vary quite essentially from the printed report, and the report of the committee as it is actually made has never been submitted to the inspection of the members of the Association until this moment. If there is any force in that, I think the members of the convention will agree that we should postpone.

H. H. Goodell. You must remember that this matter was taken entirely out of the hands of the executive committee. It was acted upon on the floor of the convention and the special committee appointed and the executive committee has had nothing to do with it.

The Chairman. The question before us is on the adoption of the report of the committee. The Chair would like, under the circumstances, to take an unusual step, and ask if the mover of the original motion is willing to accept this motion to receive the report of the committee. As the Chair understands President Patterson, that was the intent of his motion, and not to adopt the report in full, as the adoption might place us in an embarrassing position. Does the mover and seconder of that motion accept that modification to receive and proceed to act upon the report of the committee.

A Member. Before the vote is taken I would like to ask for a decision by the Chair as to whether a sufficient constitutional notice has been given or not, in order that those who wish to be governed by that consideration and not by other considerations may receive due enlightenment. The point to be decided by the Chair is this, whether that article of the constitution which is headed "amendments," and which reads: "This constitution may be amended at any regular convention of the Association by a two-thirds vote of the delegates present, if the number constitute a quorum: Provided, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given in the call for the convention."

The question is whether this article of the constitution means that a year's notice shall be given, or that the two-months notice accompanying the call for the convention is sufficient notice? I think that is an important matter and has a strong bearing upon the question that we are now considering and that it should be settled now. I ask for a decision of the Chair on that point.

The CHAIRMAN. The Chair would rule that taken technically the provisions of the constitution have not been complied with. But inasmuch as the convention took this action I would prefer that the convention should make its own ruling and proceed to act upon the matter as it shall see fit.

A MEMBER. I suppose, Mr. Chairman, that the usual parliamentary rule would govern here, requiring a two-thirds vote to overrule a decision of the Chair. However, if the convention acted contrary to the constitution, and did it by a mere majority vote, and if there is no record of a two-thirds vote, it might well be a question whether the action of the last convention in stating that its action was due notice was properly taken, especially in view of the absence of the record of a sufficient vote to overcome an unparliamentary proceeding, to wit, a two-thirds vote. Whether that would be sufficient to make constitutional the action of the convention by a mere vote when it proceeded to override its own constitution would be the next point that I would suggest.

E. A. BRYAN, of Washington. I would suggest that the question now before the convention is whether or not the motion of the gentleman from Kentucky is in order under the constitution.

The CHAIRMAN. The Chair is in doubt as to what should be done in this matter, but it seems to be the sense of the convention that a vote should be taken upon Dr. Atherton's motion, and the Chair would so rule. Dr. Atherton's motion is before the convention. The question now before you is the postponement of this report for one year.

C. S. MURKLAND. Does this mean that at the next annual meeting we must adopt or reject the proposed amendments exactly as they are?

G. W. ATHERTON. Oh no; not in the slightest. The constitution specifically provides that every such amendment shall be subject to modification or amendment in the same manner as other propositions.

The motion was put and carried, but subsequently the convention voted to reconsider.

C. S. MURKLAND. I would like to know whether this action will leave it in the power of this committee to reconsider its own action in any respect relative to its recommendations to this house?

The CHAIRMAN. The Chair would rule that it did not. The Chair now rules that this report is before us and the question is merely upon the postponement of the report of the committee, but that so far as changes are concerned it is taken out of the hands of the committee.

C. S. MURKLAND. Then, Mr. Chairman, if this matter is taken out of the hands of the committee to which it was originally referred, what is the object of the motion of the gentleman from Pennsylvania in continuing this committee?

G. W. ATHERTON. The sole object of the mover of that motion was to indicate that there was no purpose to interfere with the adoption of any amendment that the Association might wish to adopt. It is necessary in such a case to have all such questions in the hands of some proper custodian, and the committee that was first appointed appears to be the proper custodian. I do not wish to object to that at all. I am perfectly willing to have the matter left in the hands of the committee, or the secretary or executive committee, but at the same time it seems to me only courteous to leave it in charge of the committee which has brought in this report. The sole object of the mover of that motion was to insist that the notice called for by the constitution should be given.

E. A. Bryan. I would like to ask if the ruling of the Chair is that such notice is to be published for one year, and also must it be published a second time. The motion would seem to indicate that this must be printed and in the hands of this convention for another year, no change being made in that year. Then, also, our constitution says that it must be published in the call of the convention. I understand the ruling of the Chair to be upon President Patterson's motion that it was out of order, because the report has not been published and in the hands of the convention for a year.

M. A. Scovell, of Kentucky. It seems to me that the intent of the constitution has been fully complied with, as it is admitted as a fact that the committee sent out copies of the proposed changes to every member. In the first place, notice was given in San Francisco that the constitution was to be amended, and, in the second place, by these circulars which were sent out, which gave the proposed changes.

The Chairman. The question before you is on the motion to defer for one year.

On this question the roll was called.

C. S. Murkland. I want to say, Mr. Chairman, in casting my vote upon this matter, that I think there is a question whether full notice has been given and in the proper form in the call for the convention, and on that ground I will vote "aye" to this resolution.

G. T. Winston, of North Carolina. I desire to say, Mr. Chairman, that I vote "aye" to postpone, although I am in favor of the amendments which have been offered. I think, though, it is not of the greatest importance that these amendments be adopted this year, and that it is of the greatest importance that the members of this Association understand that they have a constitution which will be carried out and which will not be violated in any technical sense or on any other point. While I am of the opinion that the language of this constitution does not require that a full year's notice be given, yet it seems to me that this convention has been of the opinion heretofore that such questions as this should not be taken up except in that way, and that the notice shall be given. Furthermore, in this instance it seems to me that the notice is not sufficient, because it did not give the text of what it is proposed to incorporate in the constitution.

The Chairman. The Chair will announce that there are 32 "ayes" and 6 "noes." The motion, having received a majority of the votes cast, is adopted.

G. T. Winston. Mr. Chairman, I move that this committee be instructed to insert the following in the third line of the section, under the head of "amendments:"

"Provided that notice of any proposed amendments, together with the text thereof and the name of the mover, shall be given at the preceding annual convention and also embodied in the call for the convention."

I make this motion to put an end to any future misunderstanding in regard to the interpretation of this part of the constitution.

W. O. Thompson, of Ohio. Mr. Chairman, I would like to inquire if this motion can be entertained? This committee was charged with a particular duty. Now, if there is a motion that notice shall be given, it becomes the property of the Association and will come up in the next programme. It doesn't seem to me necessary that anything of the kind should be done here to-day. When this report comes before the Association for action it can be amended at that time. This committee that was appointed a year ago was charged with the duty of revising the constitution and was instructed to report to the Association. Now, it does not seem to me that a motion can be received at this time instructing the committee in regard to something which is before the Association.

The Chairman. The Chair would rule that the view taken of this matter by President Thompson is correct; that this notice becomes the property of the convention, and under the ruling there would be no motion before the house.

J. K. Patterson. Mr. Chairman, I offer the following amendment to the constitu-

tion: First, that the name of this Association be changed from its present style, namely, "The Association of American Agricultural Colleges and Experiment Stations," to that of "The Association of National Colleges and Experiment Stations."

Second, that all officers of this Association be elected by ballot upon nominations made upon the floor of the convention.

The CHAIRMAN. The resolution offered by President Patterson will go to the executive committee.

W. H. JORDAN, of New York. Mr. Chairman, it strikes me that it is entirely out of order to amend the report by any substitution whatever.

The CHAIRMAN. The Chair would rule that this is not a substitution, and that the members may offer these resolutions at this time if they desire.

J. K. PATTERSON. I would offer another amendment, to read as follows: "The Association shall be organized into sections upon college work and experiment-station work." Strike out the rest of that section and also the parentheses in section 2.

I would offer also the following amendment relative to additional membership: "In addition to the membership already provided for in this association, every college or university established under the act of 1862 shall be entitled to one delegate or member, who shall represent the courses of study in the mechanic arts, with the right to speak and vote on all subjects which may come before this Association."

W. O. THOMPSON, of Ohio. I will also offer an amendment. I hereby give notice of an amendment changing the name of this association to "The Association of Morrill Colleges of Agriculture and Mechanic Arts, and of Hatch Experiment Stations."

C. S. MURKLAND. I would like to get the interpretation of the Chair upon article 2, under the head of "Rules of order." The second section reads: "All business or topics proposed for discussion and all resolutions submitted for consideration of the convention shall be read and then referred without debate to the executive committee."

Does this mean that all business presented to the Association must be referred without debate to the executive committee before it can be acted upon by the Association, or does it simply mean that all business proposed for discussion? The language of the section does not quite definitely indicate which, and it seems to me that it is a very important matter for us to determine. I would like to ask for an interpretation of the Chair.

The CHAIRMAN. It is understood that the expression "proposed for discussion" applies equally to the word "business" and to the word "topic."

C. S. MURKLAND. The point of my inquiry, Mr. President, is whether that article in effect precludes business in proper form, precludes the introduction of matters of business in proper form, and carrying them through without reference to the executive committee.

The CHAIRMAN. The Chair does not understand that it precludes that action upon all business brought before the convention, but only upon matters which involve discussion before the convention and which would require to be specifically arranged for upon the programme. The Chair understands the intent of that section to be simply that the executive committee may arrange for the proper and orderly consideration of important matters brought to the attention of the convention without disarrangement or interruption of the regular programme.

W. H. BREWER, of Connecticut. Mr. Chairman, do these recommendations which have been made for changes in the constitution go before the executive committee before they are ready to be acted upon?

The CHAIRMAN. The Chair understands that notice of these proposed changes is given here, and they will also be printed in the call for the fifteenth annual convention, and will come up for discussion at the next convention.

W. H. Brewer. In regard to the proposed change of name, while it may not be in order to discuss it, yet it seems to me it would be most unfortunate. There are large institutions in this country, and others which may grow up, that are not under the Hatch Act nor the Morrill Act, and which are doing good service along agricultural lines. This institution is one. Harvard maintains an agricultural department and carries on a laboratory as a sort of finishing school, and has the finest exhibition of arboriculture, not only in this country, but in the world. Now, I think it would be a most unfortunate thing for this Association to say here, "We form an aristocracy. You can come in and visit us if you please, but we have no part and parcel with you." I think it would be most unfortunate to take any such stand. It would certainly be very unjust to those institutions which are not under those acts, and especially to one I have mentioned, where they are carrying on a large laboratory and have the best arboretum in the world.

J. K. Patterson. I would like to know, Mr. President, whether the committee upon revision of the constitution, of which you are the chairman, and which was appointed a year ago, is still in existence, or whether it has now ceased?

The Chairman. Under the motion made by President Atherton, of Pennsylvania, the committee is continued for a year. Are there any of the sections ready to report their officers at this time?

J. L. Hills, of Vermont. Mr. Chairman, the Section on Agriculture and Chemistry reports C. D. Woods, of Maine, for president, and H. J. Waters, of Missouri, for secretary.

Nominations approved.

G. W. Atherton, for the committee on military instruction in land-grant colleges, reported as follows:

Report of the Committee on Military Instruction in Land-Grant Colleges.

Mr. President, I have only a very brief verbal report to make. Dr. Harris, of Maine, who is the secretary, and who has done most of the work, is absent, and went away without giving me notice of his intention, so that I had no opportunity of conferring with him. The convention will be gratified to know, however, that in an interview with the Secretary of War he gave a very cordial reception to the suggestions as to military instruction in the colleges, and that it might in some way be brought into a kind of affiliation with the work at West Point Academy and with the commission which has been appointed by the President to consider and report upon this whole subject of what might be called graduate military instruction. He said also, in the course of the conversation, that he would try to bring the committee into communication with General Ludlow and his commission. I have to suggest, therefore, that if the matter is to be continued, this committee will need to be continued or another one appointed. I would like to say, with entire frankness to my brethren here, that I have not the time to give very much attention to it, and I should be glad to have some one put upon the committee in my place. I shall certainly not object to having any substitution made for myself. I make this report, and move that the committee be continued.

The report was approved.

A. C. True submitted the following report of the committee on the methods of teaching agriculture: In the absence of the chairman of the committee, I can only say that the committee has not been able to hold any meetings during the year, only two out of five members being present in this Association. The committee, however, has been at work with a view of completing a syllabus for the three remaining subjects which are on our general scheme. I think within a short time we can get the syllabus in shape for printing. Therefore I would ask for the committee that it be continued and given permission to print such a syllabus, as soon as it is in proper form, for the information of the Association. The report was approved.

The syllabus as afterwards prepared by the committee is as follows:

Fifth Report of Committee on Methods of Teaching Agriculture.[1]

The committee on methods of teaching agriculture submits a fifth report of progress. During the past year the committee has studied the three general subdivisions of the subject of agriculture not outlined in its previous reports and has formulated a syllabus for each of these subjects, which is given in the present report. This completes the general survey of the college course in agriculture, according to the programme laid down by the committee in its second report, in which the subject of agriculture was divided into five subdivisions—agronomy, zootechny, agrotechny, rural engineering, and rural economics. It will now be the aim of the committee to secure further study and discussion of this course and to gather the results of its application to the actual requirements of agricultural colleges, with a view to making such modifications in this programme as experience may demonstrate to be desirable. It is also hoped that the completion of this general survey of a course in agriculture will open the way for the committee to devote itself hereafter to the more detailed study of special features of instruction in agriculture, with a view to aiding still further the movement now in active progress in this country for strengthening and developing courses in agriculture to meet the needs of various classes of students.

SYLLABUS OF COURSE IN AGROTECHNY.

In its broadest sense agrotechny would include a wide range of subjects, such as the making of butter, cheese, sugar, starch, vegetable and animal oils, vinegar, concentrated foods and feeding stuffs, canned goods, malt and alcoholic liquors, textiles, and leather. For the purposes of a general college course in agriculture in the United States it will ordinarily include only dairying, with brief treatment of other industries locally important, e. g., sugar in Louisiana, Nebraska, and Vermont; olive oil in California; cotton goods in South Carolina, Georgia, and Mississippi; flour in Minnesota; meat products in Illinois, and corn products in Kansas. In the following outline, therefore, provision is made for such brief introductory consideration of the subject as a whole, and more detailed treatment of dairying, as may be reasonably given in the time (72 hours) assigned to agrotechny in the general course in agriculture. It is not intended in this syllabus to cover the requirements of special schools and courses in dairying, sugar making, etc. This matter requires special attention and may be taken up by the committee at some future time.

General outline of topics in agrotechny.

- Definition
  - Agrotechny is the theory and practice of the conversion of raw materials produced by agriculture into manufactured articles for use in commerce and the arts.
- The raw material
  - Source.
  - Standard
    - Properties.
    - Departures from standard
      - Natural.
      - Artificial.
    - Determination.
  - Handling.
  - Uses.
- Manufacture
  - Processes.
  - Equipment.
- The product
  - Description.
  - Standard
    - Properties.
    - Departures from standard.
    - Determination.
  - Handling.
  - Marketing.
  - Uses.

[1] For previous reports see U. S. Dept. Agr., Office of Experiment Stations Buls. 41, p. 57; 49, p. 29; 65, p. 79, and 76, p. 39; and Circs. 32, 37, 39, and 41.

- **The raw material**
  - Source
    - Kind of animal.
    - Physiology of secretion.
    - Milking
      - Frequency.
      - Regularity.
      - Method
        - By hand.
        - By machine.
  - Standard
    - Properties
      - Physical.
      - Chemical.
      - Biological.
    - Departures from standard.
      - Natural
        - Due to animal
          - Lactation.
          - Food.
          - Environment.
        - Due to micro-organisms.
      - Artificial
        - Impurities.
        - Adulteration.
    - Determination
      - For specific gravity.
      - For fat.
      - For organisms.
      - For impurities.
      - For adulteration.
  - Handling
    - Cleanliness
      - Stables
      - Cows.
      - Attendants.
      - Vessels.
    - Control of fermentation
      - Prevention of infection.
      - Refrigeration.
      - Aeration.
      - Pasteurization.
      - Sterilization.
  - Uses[1]
    - For consumption as milk or cream.
    - For condensed milk or cream.
    - For butter.
    - For cheese.
    - For artificial beverages.
    - For sugar.
    - For casein preparations.

- **Milk and cream for consumption**
  - Preparation for sale
    - Removal of sediment
      - Straining.
      - Centrifugal.
      - Separation.
    - Standardizing.
    - Creaming as affected by
      - Pasteurization.
      - Centrifugal.
      - Separation.
    - Packages
      - Cans.
      - Bottles.
    - Bottling
      - Washing.
      - Sterilizing.
      - Filling.
      - Capping.
  - Delivery and sale
    - Wagons.
    - Tickets.
    - Accounts.

[1] In this syllabus only the following uses of milk will be considered in detail: (1) For consumption, (2) for butter, and (3) for cheese.

Dairying—Continued.

- BUTTER MAKING (Manufacture.)
  - Processes
    - Theory.
    - Creaming
      - Gravity
        - Shallow pans.
        - Deep cans
          - Shot-gun cans.
          - "Cooley" system.
          - Dilution separators.
      - Centrifugal (separator)
        - History.
        - Theory.
        - Styles and types.
        - Operation
          - Setting.
          - Speeding.
          - Inflow.
          - Regulation of cream.
    - Ripening
      - Purpose.
      - Temperature
        - Cooling after separating.
        - Reheating.
      - Starters
        - Natural
          - Sour cream.
          - Sour milk.
          - Buttermilk.
        - Artificial
          - Preparation.
          - Propagation.
          - Use.
      - Determination of ripeness
        - Appearance.
        - Consistency.
        - Acidity
          - Taste.
          - Acid tests.
    - Churning
      - Theory.
      - Temperature.
      - Breaking.
      - Difficult churning.
      - Churns
        - Form.
        - Size.
        - Speed.
    - Finishing
      - Removal of buttermilk.
      - Addition of salt
        - Brine.
        - Dry.
      - Working
        - Purpose.
        - Amount necessary.
        - Temperature.
    - Packing
      - Prints
        - Apparatus.
        - Covers.
      - Tubs
        - Sizes.
        - Materials.
      - Stone jars.
      - Paper packages.
  - Equipment
    - Farm dairy
    - Creamery
      - Location.
      - Construction.
      - Arrangement.
      - Equipment.
      - Management.

Dairying—Continued.

- **Butter** (The product.)
  - Description.
  - Standard
    - Properties
      - Physical
        - Texture.
        - Color.
        - Finish.
      - Chemical.
      - Biological — Flavor.
    - Departures from standard.
    - Determination.
  - Handling.
  - Marketing.
  - Uses.

- **Cheese making** (Manufacture.)
  - Processes
    - Theory.
    - Kinds of cheese
      - Cheddar.
      - Swiss.
      - Brick.
      - Limburger.
      - Foreign varieties (Roquefort, etc.).
    - Preparation of milk.
    - Separation and manipulation of curd.
      - Rennet
        - Source.
        - Preparation.
        - Action.
      - Setting.
      - Cutting.
      - Heating.
      - Cheddaring.
      - Grinding.
    - Salting.
    - Pressing.
    - Curing.
    - Packing.
  - Equipment
    - Factory
      - Location.
      - Construction.
      - Arrangement.
    - Farm diary
      - Apparatus.
      - Management.

- **Cheese** (The product.)
  - Description.
  - Standard
    - Properties
      - Physical
        - Texture.
        - Color.
        - Finish.
      - Chemical.
      - Biological — Flavor.
    - Departures from standard.
    - Determination.
  - Handling.
  - Marketing.
  - Uses.

SYLLABUS OF COURSE IN RURAL ENGINEERING.

In its most comprehensive sense rural engineering includes all the branches of civil and mechanical engineering relating to the locating, arranging, and equipping of farms, and the construction and operation of farm implements and machinery. A prerequisite to thorough knowledge of rural engineering would thus be a general course in civil and mechanical engineering. As students in an agricultural course in our colleges can not be expected to have this preliminary training (except some knowledge of surveying and the use of surveying instruments, which is quite essential), it will be necessary to confine the course in rural engineering as a part of the general course in agriculture to the more elementary matters which will be understood by such students, and which have a direct, practical bearing on farm management.

There is need of the establishment of thorough courses in rural engineering as specialties in some of our higher institutions, in order that well-trained rural engineers may be produced to act as leaders in the advancement of engineering enterprises for the benefit of agriculture.

- DEFINITION...
  - Rural engineering is the science and art of laying out farms, designing and constructing farm buildings and works, and making and using farm implements and machinery.
- LAYING OUT THE FARM...
  - Principles of selection.
  - Survey.
  - Location of buildings and works (drains, irrigation ditches, wells, and roads).
  - Division into fields and yards.
  - Map of farm.
- CONSTRUCTION OF BUILDINGS AND WORKS.....
  - Buildings.....
    - Principles of construction.
    - Materials.
    - Classification[1] ....
      - House.
      - Barn.
      - Piggery.
      - Poultry house.
      - Tool house.
      - Creamery.
      - Fences.
    - Purpose.
    - Plans.
    - Methods of building.
    - Cost.
  - Water system.....
    - Springs.
    - Wells.
    - Reservoirs.
    - Pumps and other water lifts.
    - Conduits.
    - Tanks.
    - Plumbing.

[1] The list given is only illustrative. The buildings to be discussed in this course would vary with the region, system of farming, etc.

- **Construction, etc.**
  - Irrigation system
    - Theory.
    - Water supply (sources, character, and means of obtaining).
    - Works
      - Reservoirs.
      - Canals.
      - Laterals and ditches.
      - Appliances for measurement and division of water.
    - Methods of application.
  - Drains
    - Removal of surface water (drainage of swamps, etc.).
    - Soil drainage
      - Theory.
      - Open drains.
      - Covered drains (including stone, brush, tile, etc.).
  - Sewage system.
  - Roads
    - Location.
    - Materials.
    - Construction.
    - Maintenance.

- **Construction and use of farm machinery**
  - Principles of mechanics as applied to farm machinery.
  - Classification
    - Power machines
      - Steam.
      - Gasoline.
      - Water.
      - Wind.
      - Horse.
      - Man.
    - Plows.
    - Surface-working machines.
    - Seeding machines.
    - Harvesting machines.
    - Food-preparing machines.
    - Farm vehicles.
    - Small implements.
  - Structure.
  - Operation
    - Principles.
    - Practice.
  - Repairing.

SYLLABUS OF COURSE IN RURAL ECONOMICS.

- **Definition**
  - Rural economics treats of agriculture as a means for the production, preservation, and distribution of wealth by the use of land for the growing of plants and animals. It may include the development of agriculture as a business (history of agriculture), as well as the facts and principles of farm management under present conditions.

- **History of agriculture.**
  - Development of different forms
    - Grazing.
    - Plant husbandry.
    - Mixed husbandry.
    - Special farming.
  - Agriculture in different periods (with special reference to land tenure, equipment, labor system, prominent products, social and financial condition of farmers)
    - I. Prior to 500 B. C. (Egyptian.)
    - II. 500 B. C. to 500 A. D. (Grecian and Roman.)
    - III. 500 A. D. to 1500 A. D. (Western Europe—feudal system.)
    - IV. 1500 A. D. to 1800 A. D. (Especially in Great Britain.)
    - V. 1800 A. D. to 1900 A. D. (Especially in United States.)

- Farm management.
  - Capital
    - Land
      - Value as determined by location, suitability, etc.
      - Purchase, rental, and sale.
      - Cost of maintenance
        - Taxes.
        - Rents.
        - Interest.
      - Legal requirements.
    - Equipment
      - Nature (as related to particular kinds of farming)
        - Buildings.
        - Fences, roads, wells, drains.
        - Implements.
        - Live stock.
      - Value.
      - Cost of maintenance
        - Taxes.
        - Insurance.
        - Repairs.
        - Feeding.
      - Legal requirements.
  - Labor
    - Systems (wage, share, tenant).
    - Contracts, including methods of payment.
    - Cost, as affected by labor supply, use of machinery, nature of work, etc.
    - Management.
  - Production
    - Methods and cost (with reference to different systems of farming).
  - Marketing
    - Preparation for market.
    - Choice of market.
    - Transportation.
    - Method and cost of sale.
    - Legal requirements, e. g., weights, measures, packages, commissions, inspection.
  - Records and accounts
    - Crop records.
    - Feed and milk records.
    - Breeding records.
    - Inventories.
    - Bookkeeping.

J. H. Connell,
A. C. True,
T. F. Hunt,
H. T. French,
H. H. Wing,
Committee.

The Chairman. The next in order is the report of the committee on pure food. The Chair received this morning the following telegram, dated at Raleigh, N. C., November 14, 1900:

Prospects good for passage of pure-food bill by the present Congress. Would recommend Association to continue its support of the cause.

W. A. Withers, *Chairman.*

The committee was continued.

The convention then proceeded to the consideration of miscellaneous business.

E. B. Voorhees, of New Jersey. Mr. Chairman, I am requested by Prof. R. H. Warder to introduce the following resolution:

Whereas we all feel the great need of more teaching in forestry: Therefore,

Resolved, First, that we heartily second the policy of the United States Department of Agriculture in giving practical advice and assistance to individual States, lumber-

men, farmers, and other owners in handling their woodlands and forests along the conservative lines of forestry, and would earnestly urge upon our members of Congress to encourage and support the Department in this work.

Second, We also commend Yale, Cornell, and the other universities and colleges which are establishing departments of forestry for the purpose of research and giving such practical instruction to students as will fit them for the better care and preservation of our forests.

The resolution was referred to the executive committee, reported favorably, and adopted.

L. G. Carpenter, of Colorado. Mr. Chairman, I desire, in view of the very important matter which has been brought to the attention of the Association in regard to summer schools of agriculture, to move that it be referred to the executive committee of this Association, with instructions to make inquiries and report their conclusions at the next annual meeting.

H. H. Goodell. Mr. President, the address on summer schools for agriculture made by President Thompson this morning (see p. 74) did not specify particularly what it was desired the executive committee should do. Would President Thompson be willing to put the views expressed by him in the form of a resolution to be referred to the committee, instead of this motion?

With the understanding that this was to be done, Professor Carpenter's motion prevailed.

L. G. Carpenter. In regard to this committee for cooperative work between stations and the Department of Agriculture, I would like to ask whether the committee was authorized and expected to confer with the Secretary of Agriculture as to the details of the report that it is to make.

The Chairman. The Chair understands that the committee may do so if they regard it as necessary in the prosecution of the work. In order that the matter may be clear, the Chair will rule that it is competent for the committee to do any wise act that lies within the province of the resolution adopted.

Evening Session, Thursday, November 15, 1900.

The convention was called to order at 7.40 p. m. in the parlors of the New Haven House. President Stubbs in the chair.

W. H. Jordan. I desire to present a resolution, as follows:

Resolved, That the Association hereby expresses its regret that Prof. S. W. Johnson, because of physical disability, has been unable to participate in its deliberations, and extends to him greetings of respect and good will.

Resolved, That the secretary be instructed to transmit this resolution to Professor Johnson.

I move the adoption of that resolution.

L. G. Carpenter. Mr. Chairman, I would support that motion as the sense of the Section on Agriculture and Chemistry. I have been instructed in regard to this resolution by a vote of the section, and I take pleasure in seconding the motion for its adoption.

The resolution was adopted.

L. G. Carpenter. The chairman of the Section on Horticulture and Botany, who has been called away, requests me to present the nominees for officers of that section. They are as follows: For chairman, L. R. Jones, of Vermont; secretary, W. J. Green, of Ohio.

The nominations were approved.

J. K. Patterson presented the following for officers of the Section on College Work: J. H. Raymond, of West Virginia, chairman; B. O. Aylesworth, of Colorado, secretary.

They were declared elected.

For the Section on Entomology, the following were presented and declared elected: M. V. Slingerland, of New York, chairman; H. A. Morgan, of Louisiana, secretary.

G. W. Atherton. Mr. Chairman, after a consultation with several members of the Association, resolutions have been prepared in reference to the late President Smart which I would like to read:

This Association desires to express its appreciation of the character and services of a former fellow-member, the late James H. Smart, LL.D., president of Purdue University, Indiana. Dr. Smart was for many years engaged in the work of public education in its various stages, and in every stage of his career showed unusual insight into the conditions with which he had to deal, together with a remarkable readiness of resource and administrative ability. The university over which he presided for so many years is a permanent monument to his energy and zeal and tenacity of purpose, as well as to the high ideals which controlled his life and work.

As a member of this Association he will long be remembered for the wisdom of his counsel, for the clearness of his judgment, for his cheerfulness and enthusiasm, even when suffering under the burden of great physical depression, and for his inspiring courage in dealing with the problems presented from time to time to his associates in this Association, either for their consideration or action. He was a faithful and devoted friend, a fearless but courteous antagonist, and his memory will long be cherished as one of those who helped to found and establish this Association, and who endeared himself to his fellow-members by the unfailing charm and beauty of his character.

Resolved, That this memorial be placed upon the records of this Association and that a copy be transmitted to Mrs. Smart.

I move the adoption of the resolution with any modifications which may be deemed best.

The resolution was adopted.

T. F. Hunt. Mr. President, it is my pleasure and privilege to move the adoption of the following resolution and ask that a copy of the same be transmitted to Mrs. George E. Morrow:

George E. Morrow, LL. B., A. M., was ten years an editor of agricultural newspapers, twenty-three years professor of agriculture, eighteen years with the University of Illinois, six years the leading spirit in the Illinois Agricultural Experiment Station, four years president of the Oklahoma Agricultural and Mechanical College, and director of the station of that institution. These positions he filled with great power and fidelity.

He was a frequent and honored attendant upon the meetings of this Association, and was in 1894 its presiding officer.

Of the many activities of the generous life of President Morrow the cause of agricultural education lay nearest to his heart. As a teacher, as a public speaker, and in his intercourse with men, he maintained firmly, but without exaggeration, his faith in the ultimate success of this cause. The good which he accomplished for agricultural education in its pioneer days was his greatest work.

Professor Morrow was one of God's noblemen, an inspiring teacher, a devoted and true friend.

This Association records its gratitude for and its appreciation of his wise counsels and devoted services to the ends which this Association strives to attain.

The resolution was adopted.

H. H. Goodell. I have been requested to read the following resolution by the Section on Agriculture and Chemistry, having reference to the late Sir John Bennet Lawes:

Resolved, That the Association of American Agricultural Colleges and Experiment Stations hereby expresses its appreciation of the life, labors, and character of Sir John Bennet Lawes, Bart., LL. D., F. R. S., of Rothamsted, England, who, by his work as an investigator in cooperation with Sir Henry Gilbert, LL. D., F. R. S., and by his munificence in instituting, maintaining, and providing for the permanent establishment of the first and greatest of the experiment stations in the British Empire, as well as by his interest in and generous attitude toward American agriculture, research, and education, especially as manifested by publications and by lectures, has won for himself and his associates the profound respect and gratitude of the friends of agricultural science, not only in his own country, but also throughout the world.

Resolved, That copies of these resolutions be transmitted to Sir Charles Bennet Lawes, Bart., and Sir Henry Gilbert, LL. D., F. R. S., and to the Secretary of the Lawes Agricultural Trust.

Respectfully submitted.

W. O. Atwater,
H. P. Armsby,
W. H. Brewer,
W. H. Jordan,
I. P. Roberts,
A. C. True,
Committee.

The committee has thought that it might be of interest to the friends of Sir John Lawes to know that the convention which passed the resolutions was attended by considerably over 100 members, representing 39 States and Territories, and including 26 presidents of colleges and universities and 18 directors of experiment stations, all, or nearly all, being workers in these lines.

The resolutions were unanimously adopted, and, on motion of L. G. Carpenter, the secretary was instructed to engross them and transmit them to the friends of Sir John Lawes.

A. Cope, of Ohio. Mr. President, I desire to offer the following resolution:

(1) *Resolved*, That the thanks of this Association be, and hereby are, tendered to President Hadley and the authorities of Yale University for courtesies extended, and especially to Professor Brewer and Dr. Jenkins for the careful and convenient arrangements made by them for the sessions of the convention and of the several sections.

(2) *Resolved*, That the Association records its appreciation of courtesies extended by Wesleyan University, tendered through President Raymond and Dr. Atwater, and expresses its thanks for their personal interest and attention, which made the session at that institution so pleasant and profitable.

The resolutions were adopted.

The Chairman (in reply to a point raised by J. K. Patterson, of Kentucky). The rule in the constitution in regard to amendments reads as follows: "Notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given in the call for the convention." A number of resolutions amending the constitution have been proposed to-day, and the Chair understands that the status of the question is this: The proposed changes in the constitution as submitted by the committee on revision remain as they were given this morning, and that the various resolutions offered by way of amendment shall be printed in the call for the next convention. The Chair further understands that all such resolutions having the names of the movers attached to them will have these names printed with the resolutions in the call for the convention. Under the rule the amendment goes to the committee without debate. Another paragraph of this rule states: "This constitution may be amended at any regular convention of the Association by a two-thirds vote of the delegates present, if the number constitutes a quorum: *Provided*, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall be given in the call for the convention." The Chair would interpret that language to mean that any amendment to the constitution must needs be offered at the convention next preceding the convention at which action was taken, for the reason that the resolution must be presented and entered upon the record. Therefore it has to practically lie over for a year. In other words, it would not be proper for an amendment to the constitution to be sent into the executive committee after the adjournment of this convention and then the amendment placed by the committee in the call, according to a strict construction of the language.

J. K. Patterson. How would it be when the revision of the constitution was ordered, as was the case last year, and when there were no specific amendments offered at that time? The constitution was directed to be revised and a committee was appointed for that purpose. It was an entire revision of the whole instrument

that the committee was ordered to make. From that point of view I think the postponement until another year was altogether *ultra vires.*

The CHAIRMAN. Inasmuch as the question has gone beyond the power of the convention at this time, the Chair does not feel called upon to pass upon the point raised by President Patterson. The Chair would not hesitate to do so if it were necessary, but will take refuge in that fact.

J. K. PATTERSON. Inasmuch as the revision of the whole instrument was ordered, it seems to me that the action taken to-day was altogether unwarranted and altogether without constitutional warrant. That is the reason why I asked for the opinion of the Chair upon the subject. It was not simply an amendment of the constitution that was ordered. It was not a single amendment that was proposed, and it was not to propose amendments; but the directions of the convention to the committee were for a revision of the entire instrument. That is what was ordered, and the committee was appointed for that purpose. Now, inasmuch as that was the case, it does not seem to me that it comes within the rules at all which are laid down to govern the introduction of amendments.

G. W. ATHERTON. I do not wish to thrash over old straw, but it seems to me so plain on the face of it and so certainly in accord with all recognized practice that there ought not to be any serious question. The point is simply this: The constitution provides the way in which it can be changed. Now, no matter whether you call it an amendment of the constitution or a revision of the constitution it amounts to the same thing, and the instrument itself prescribes the way in which it shall be done. It would make no difference either way. The changing of the word doesn't alter the fact. Our constitution can be amended in one way and in only one way.

J. K. PATTERSON. I agree that it can be amended in only one way, but it is not a question of amendment, but a question of revision of the whole instrument. I do not think you would find any competent judicial opinion that would sustain that view.

The CHAIRMAN. Is there anything further to come before the Association? If not, we have come to the time when this Association of American Agricultural Colleges may adjourn without date. In glancing over the work of the convention it is very gratifying to me to note the large attendance, especially upon the session of the Section on Agriculture and Chemistry, and also the Section on Entomology, which has had a large attendance this year, as well as the Section on Horticulture and Botany. The programme of the Section or College Work was fully appreciated, and the section was treated to a very excellent paper by its chairman, President Patterson, of Kentucky. The work in general has been very satisfactory and helpful to the members of the Association, perhaps not excepting the discussion of the constitution itself.

I desire to express to the members present my sincere thanks for their patience and never-failing courtesy to the Chair in the discharge of his duties, and to say further that while I am very glad to lay down the gavel I shall ever carry in my mind and in my heart a sense of high esteem and kind appreciation for the honor which I have enjoyed of presiding over this body of useful, earnest, and distinguished men.

W. H. JORDAN. I neglected to bring up a little matter of business. A person who has charge of the stock interest of the Pan-American Exposition desires that some member of this Association shall be appointed as associate or as the representative of the stock interests in the management of the dairy exhibit at that Exposition. In bringing this matter before you I am fulfilling a promise which I gave to bring it up. I desire to move that the executive committee be authorized to appoint such a representative in the interest of this Association. I do not understand, Mr. Chairman, that he must be in attendance, but simply to consult with the representative in the matter. The duties are not laborious nor expensive.

The executive committee was authorized to make such appointment, the appointee to bear his own expenses.

A. C. True. I desire to offer on behalf of the Association a resolution of thanks for the able and impartial way in which the president of this Association has presided over our deliberations during this session.

J. K. Patterson. I desire to couple with that an expression of appreciation of this convention for the most excellent and admirable address delivered by the president of the Association to this fourteenth annual convention.

The amended resolution was unanimously adopted.

Lectures on Investigations at Rothamsted.

During the convention Dr. Bernard Dyer, of London, England, representing the Lawes Agricultural Trust, delivered a series of lectures based mainly on the investigations at Rothamsted, England, of soils which have been continuously in wheat for many years.[1]

On motion of L. G. Carpenter, a resolution of thanks and appreciation was unanimously voted Dr. Dyer, to which the latter responded as follows:

May I express my sentiment of gratitude for the kind resolution which you have adopted. I should like to say to you that I feel that my selection by the Lawes Agricultural Trust committee was the greatest honor that has been conferred upon me during my life, and certainly the execution of the mission has been most pleasurable and enjoyable. I have to thank you for the most cordial, hearty, and kind reception which you have accorded me.

The Chairman. I am sure, Dr. Dyer, I express to you the sentiment of our members when I say that we wish that your short stay in the country visiting stations and colleges may be full of pleasure and profit, and that you may have a safe and pleasant passage to your home.

The secretary of the Association was instructed to request the Secretary of Agriculture to publish the lectures.

The convention then adjourned sine die.

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[1] For a brief synopsis of these lectures see Experiment Station Record, 12, p. 407.

MINUTES OF THE SECTIONS.

SECTION ON COLLEGE WORK.

The only formal paper before this section was one by J. K. Patterson, of Kentucky, on the "General drift of education at the land-grant colleges," the time being occupied by discussion of various subjects.

General Drift of Education at the Land-Grant Colleges.

The law of Congress approved July 2, 1862, which made provision for the establishment, endowment, and maintenance of agricultural and mechanical colleges, set forth in section 4 of the act that "The leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic acts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

In this section certain lines of work are made obligatory, viz, "military tactics," those branches of learning "related to agriculture," and those branches of learning "related to mechanic arts." Of these three it may be conceded that, while all are obligatory, "agriculture and the mechanic arts" are relatively of primary importance and "military tactics" of secondary importance. There are certain other lines of work which are permissive, viz, "the scientific and classical studies." It is, I believe, a fair interpretation of the two groups that the obligatory is considered the more important and the permissive the less important, so far as the purposes of the act are concerned. The intent is set forth in the concluding lines of the section, viz, "to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

It will be observed that it is within the exclusive competency of the legislatures of the respective States to determine whether the colleges established under the act shall be limited and bounded by the obligatory features of the act or whether they shall, in the exercise of a wise liberality, make provision for the inclusion of "other scientific and classical studies;" also, if they adopt the latter alternative, then the institutions founded under the act make their instruction liberal as well as practical.

It may not be inappropriate to consider for a few minutes how far the intentions of the founder have been realized.

Many of the institutions founded under the act have large incomes, accruing partly from the interest on the proceeds of the land grant, partly from liberal appropriations from the respective States. In some instances State aid surpasses the income from the legislation of Congress.

In a meeting in Washington in 1885, when I expressed the conviction that compliance in good faith with the organic law required daily instruction in military science and daily drill I was met with a storm of dissent from every quarter of the house. The idea of daily military drill and instruction was scouted and ridiculed. After a few years military instruction grew somewhat more in favor. Some colleges had military instruction twice each week; some three times; some every day. The college which I represent has maintained the principle of daily drills and military instruction, and has required every man during his college connection to do military service.

The good results of military instruction in the land-grant colleges were apparent during the war with Spain and the military operations subsequently in the Philippines. Every State in the Union was able through its agricultural and mechanical college to provide the necessary number of officers for the contingent which it fur-

nished for the increase of the Army, many of them quite as well educated and quite as capable as graduates of West Point. The wisdom of Senator Morrill's forecast was thus justified by results.

Irrespective of providing an educated military reserve, I believe that military instruction in these colleges is a good thing in itself and in its relations. It is a valuable element in physical training; it inculcates promptitude and exactness, promotes grace and dignity of movement, and, above all, enjoins and compels obedience and submission to wholesome discipline and restraint—one of the most important lessons to be learned in any country and especially in our own, where the coordinate ideas of liberty and authority are but imperfectly understood. For these reasons, but briefly expressed, I believe that every land-grant college in America ought to make the military feature of coordinate obligation in dignity, and should endeavor to make the military instruction as thorough and comprehensive as the act of 1862 intended that it should be.

When the statute of 1862 was passed the country was in the throes of a great national crisis. Military considerations were paramount. There was abundance of material out of which to make soldiers, but the material when listed, or later on drafted into the service, was raw and undisciplined. The officers elected by the regiments and subsequently confirmed by the States and by the War Department were as little fitted for command as the men whom they were appointed to lead. The majority of them knew nothing about the requirements for a good soldier; they could not drill the men; they could not instruct them in tactics; they knew nothing about strategy. Senator Morrill saw the necessity of providing officers, and that too out of all proportion to the ability of the Military Academy to supply. Officers who would be thoroughly drilled and able to command on the field; officers who should be well versed in the modern science of warfare. The thought suggested to him the propriety of making the colleges founded under the act military schools, schools for making soldiers as well as schools for scientific agriculturists and scientific mechanicians. The country could not afford to keep a standing army of half a million men with the proper complement of officers under arms, but it could afford at inconsiderable expense to provide for the military instruction of all who matriculate in these colleges and thus have thousands and tens of thousands of men ready at the call to arms and capable of shaping into companies, and regiments, and brigades, and divisions, and corps, and armies the volunteers and conscripts of future days. Thus the military feature was engrafted on the land-grant colleges and made a coordinate and obligatory feature of their organization. But a reaction set in after the close of the war. Men were wearied with civil strife. After four years of continuous warfare they were ready to sheath their swords and devote themselves to the ways and arts of peace.

The military feature of these colleges became generally unpopular and the amount of military instruction was reduced to a minimum, if not eliminated altogether. Between 1885 and 1897 there was a gradual revival of interest in military matters in these colleges. The War Department held out prospects for promotion to students who had graduated with honor in military science and the governing boards of the colleges and universities gradually became conscious of their duty under the law. The consequence of this awakening was that when the Spanish American war came on hundreds of educated men, well drilled in the manual of arms, familiar with tactics and strategy, were available for officers, not only in the volunteer, but in not a few instances for the Regular Army. In discipline, in aptitude, in knowledge of military science, in all that goes to make an able, intelligent, and capable officer, the graduates of land-grant colleges were able to hold their own with the best West Point men. I say this, and I say it with pride, not to disparage the graduates of the Military Academy, but in justice to our own men.

It may be well in this connection to say that by judicious and cooperative effort there is a strong probability that an appropriation can be had from the Government for establishing schools for marine engineering in connection with the existing schools of mechanical and electrical engineering which will enable the land-grant colleges to educate men for this branch of the naval service and thus to do for the Navy what they are now able to do for the Army.

Of the two objects in the mind of the author of the act of 1862—namely, the scientific development of agriculture and the application of science to the mechanic arts by providing instruction in those branches of learning relating thereto the mechanic arts seem, as measured by ultimate results, to attract more students and to graduate more students in full and relatively complete courses in the ratio of 4 or 5 to 1. In many of these colleges students in the application of science to agriculture can not be had for long courses of study. These latter have been abridged from four years to three, from three to two, from two to one, from one year to a few months or even weeks. These

truncated courses of study, necessarily meager and partial, supply some practical knowledge, but do little in the way of either scientific instruction or education. I have had occasion to collect college statistics for other purposes and find that of 20 or 30 representative colleges the number of those who completed regular courses of study which led to the bachelor's degree in agriculture and in engineering in 1900 were about 126 in the former and 620 in the latter. This seems to show that the trend of education in the land-grant colleges, so far as the purpose of the founder was concerned, is in the direction, not of agriculture, but of the mechanic arts. In some of these colleges the graduates in classics and in other scientific studies outnumber both the one and the other. This seems to indicate that though agriculture is encouraged by farmer's institutes and all the machinery which ingenuity can devise for its upbuilding and growth, farmer's do not care to educate their sons in agriculture, or the sons object to the kind of education specially provided for them. Farmers in most parts of the country, I think, prefer when they send their sons to college, to educate them for professional life, as lawyers, clergymen, physicians, engineers, or anything, indeed, but farmers. On the other hand merchants, bankers, professional men, gentlemen of fortune and gentlemen of leisure prefer for the most part a liberal education for their sons, though many place them in engineering schools.

The aggregate agricultural productions are large, but few farmers are rich. They are not rich in the sense that merchants and contractors and manufacturers and iron-masters and railroad magnates are rich. Many of them are, it is true, well off. But of the thousands of millionaires and multimillionaires in America how many of them became rich by farming? This I imagine is the main reason why the agricultural side of the land-grant colleges do not flourish as the mechanic arts and scientific branches and classical and philosophical subdivisions do. If then I were to sum up the work of the colleges outside of the experiment stations, I should say that engineering and classical education and philosophical training take the lead, and that agriculture follows, oftentimes with a halting, limping gait and considerably behind. From many points of view this is to be regretted. I can not but look on the agriculturist as the mainstay of the country, and that upon his education and intelligence and patriotism the perpetuity of free institutions depends. An approximately correct diagnosis may lead to a remedy.

The scientific instruction in these colleges outside of agriculture and the mechanic arts has had a great and gratifying development. Those sciences which deal with matter and with life in their broadest extent have been cultivated for their own sake and not because of their relation to agriculture and the mechanic arts. The boundary lines between the known and unknown have been pushed back from year to year, enlarging the domain of realized knowledge to a degree which could not have been anticipated a generation ago. The far-reaching generalizations of Darwin and the practical discoveries of Pasteur, with their manifold applications in theory and practice, gave a notable impulse to discovery based upon observation and experiment. In these the land-grant colleges have taken the lead in America. They have, moreover, been largely instrumental in stimulating increased attention to natural science in many of the older institutions of the country. Harvard and Yale and Princeton and Columbia have followed the example, though somewhat reluctantly at first, of the colleges established under the act of 1862, and have spent large sums of money in equipments for physical, chemical, and biological instruction and research. They have not, however, been able to keep pace with the State colleges and universities in scientific investigation and instruction. These latter institutions, drawing largely from the liberality of their respective commonwealths, have had resources at their command which even the best of the old universities with their princely endowments were unable to equal. The effect has been to liberalize and widen the scope of university work, and to modify the character of the old scholastic training by the introduction of a much-needed leaven drawn directly from the daily operations of nature in her own great laboratory. While the land-grant colleges have given a wholesome stimulus to scientific investigation and discovery in the older colleges and universities, these latter have been instrumental in causing the State institutions to introduce a large element of liberal culture into their courses of study. Philosophy, literature and classics, and modern languages and comparative philology, Aryan and Semitic, find adequate recognition in most of the higher institutions founded under the act of 1862. These are permitted by the organic law, and in connection with the scientific courses afford educational facilities unsurpassed on the Western Continent. Classical and philosophical training have held their own for centuries. The natural sciences have not superseded them, nor are they likely to do so. As a means of mental development and of mental discipline, of the cultivation of the mind as an instrument for the perfection of thought, Latin, Greek, logic, and metaphysics have no superior, and it is doubtful whether they have or will have an equal.

The roots of our modern civilization go back to the language and literature and philosophy of the "dead but sceptered sovereigns who still rule our spirits from their urn." It is impossible to dissociate ourselves from the civilizations of the distant past. And in this age of intense devotion to material things, to the multiplication of the products of the field and the forge and the loom, to the improvement of the facilities for intercommunication; in this age of steamships and railroads and telegraphs; of manufactures and commerce reaching out to the ends of the earth and seeking new spheres of influence and new fields of enterprise; in this age of intense devotion to the accumulation of wealth, it is well that the desire should exist to educate and develop the intellect on lines that do not stimulate and impel its possessor to transform his brain into a mint for the coinage of gold and silver. For this purpose classics and the liberal arts—the humanities, as they were very properly designated—provide the necessary conditions and supply the proper counterpart. The bread and butter sciences are needful, nay indispensable, but "man does not live by bread alone."

To build machinery for agriculture, for manufactures, for locomotion, is well. To breed poultry, to fatten pigs, to develop beef in cattle and speed in horses, to multiply the return from the fields of wheat and corn and cotton and cane, increase the comforts and conveniences and well-being of life. These are the material conditions of civilization and refinement, but these are not ends in themselves; they are means to the attainment of a higher end. They should rightly subserve the development of the intellect, the growth of intelligence, the discipline of the mental faculties, the quickening of the moral powers, the cultivation of the æsthetic powers, to the end that the true, the beautiful, and the good should find symmetrical and harmonious growth. Then would we understand and live for the sublime truth that "on earth there's nothing great but man, in man there's nothing great but mind." Then would be realized the ideal of the founder to provide an education at once practical and liberal "for the industrial classes in the several pursuits and professions in life." Culture and refinement and intelligence and humanity and an enlightened patriotism will then be possible in the homes of the masses as well as in the stately mansions of the classes. In the former rests the hope of the future, and not in the wealthy few whose accumulated fortunes are counted by tens and hundreds of millions.

"Ill fares the land to hastening ills a prey
Where wealth accumulates and men decay.
Princes and lords may flourish or may fade;
A breath can make them as a breath has made.
But a bold peasantry—their country's pride,
When once destroyed can never be supplied."

SECTION ON AGRICULTURE AND CHEMISTRY.

The sessions of this section were held at Yale and Wesleyan universities on the afternoons of November 13, 14, and 15, 1900, L. G. Carpenter, of Colorado, chairman of the section, presiding.

E. H. Jenkins, of Connecticut, read the following paper:

Methods of Experimenting with Cigar-Wrapper Leaf.

No other crop which we raise makes such large drafts on the fertility of the soil as wrapper leaf tobacco. It takes yearly not far from 100 pounds each of nitrogen and of lime, 16 of phosphoric acid, and from 130 to 150 pounds of potash per acre. The proper fertilization of this crop is the more important because in the first place it is raised continuously on the same land, the quality of leaf being better than when raised in rotation; and secondly, because only very light, sandy, and naturally rather unproductive soils are suited to the cultivation of cigar leaf tobacco under present trade conditions.

There is no other crop which is so exposed to damage or destruction between the times when it is harvested and when it is sold. Pole burn, for example, within forty-eight hours may absolutely ruin a crop which was in perfect condition at harvest and worth more than $400 per acre. The selling price of few if any

other crops is so dependent on the quality of the product rather than on its quantity. This year, for instance, our best crops have sold at 28 to 30 cents, assorted; but there are other crops raised in the same valley, which, by reason of accidents or lack of judgment and skill on the part of the grower, will sell after long waiting for 7 or 8 cents.

Whatever is true of other lines of experiment, I am sure that in the case of tobacco it is necessary that the one who plans the work should have his hand in the practical execution of it from beginning to end. However skillful the person in practical charge of the field work may be, the director or the one who is to write up the work and state the conclusions, must be frequently in the field, must know every detail of it, must have his own hands in it, and must follow the leaf through the cure and the fermentation to the end, if he would be able to talk confidently about it. This is one of the duties of the director of an agricultural station which do not appear in any formal statement, but which naturally fall on him like an unexpected rain, and which make him a servant of servants.

No crop is more profitable when it is at its best; no crop can make a more absolute, dismal, and expensive failure at its worst. In view of all these things, there is no crop which is a more interesting and fruitful subject for careful experiment.

In this paper there is only time to very briefly outline a few things regarding experimental methods, suggested by eight years of work on tobacco, and I do this not for the instruction of those of us who are in this work, but rather for some suggestion there may be in it to those who are interested in other lines.

The character of the tobacco leaf is to a great degree dependent on the physical character of the soil in which it grows, as Mr. Whitney, of the Department of Agriculture, has most convincingly shown. A light-colored thin wrapper leaf can not be raised on moderately heavy moist soil, such as is suitable for grass and grain; nor can full-bodied cigar filler be raised on light soil, such as is most suitable for wrappers.

The soil itself is a controlling factor. I have here a map of the Connecticut Valley, each variety of soil being noted by a distinctive color, the whole being the work of Mr. Whitney and his assistants. Here, within the small compass of a valley in the center of Connecticut and Massachusetts, consisting of light sandy alluvial terraces and plains, are eleven different grades of soil. The tobacco raised on these show characteristic differences of quality, some very slight, others very marked, all of them easily recognized by the growers themselves.

Slight differences of climate or meteorological conditions also affect the character of the leaf. For example, wrapper leaf can not be profitably grown within 20 miles of salt water. We have soils on our coast well suited to tobacco, but while the yield is satisfactory the quality of tobacco raised there is poor. The leaf is thick and heavy and does not burn properly.

It follows from all this that the place selected for experiments on this crop, as for experiments on any other, should be where the crop is raised to the greatest perfection, not necessarily near the station, nor even where it is easy of access. Soil and climate, not convenience, must settle the location.

If possible the station should own the land over which it experiments, or at least have absolute control of it, and it should by all means own the crop which is raised on it. Experiments are not usually operations which are financially profitable in themselves. The experimenter should not be hampered by the feeling that his work may involve loss to the farmer. He should be free to do anything with the crop that promises to throw light on the subject under experiment, regardless of its effects on the selling price.

It is of the first importance to the experimenter, as I shall explain later, to hold the crop in his possession until it has been seasoned and fermented. It is of great importance to the practical farmer that he should sell his crop and get his pay for it just as soon as possible, and always before it is fermented. The interests of the farmer and the experimenter are not therefore at all identical, and a partnership, like that involved in most cooperative experiments, is not likely, in case of the tobacco crop, to be mutually satisfactory.

From the time when the seed beds are made ready until the cured leaf is stripped and bundled, all through the growing and curing season, it is of the utmost importance that the crop should be in charge of an experienced and successful grower of tobacco. Faithful attention to instructions is not all. The one personally in charge must himself know every detail and must be in the field with his men.

The method of topping and the time of cutting, for instance, are both matters of vital importance. Topping too high or too low, or cutting a few days too soon or too late, very greatly diminishes the quality and with it the market price of the crop. No instructions, however minute, are of any avail. The man in the field must know certainly by all those signs which no instructions can describe and which the

experienced tobacco grower himself can hardly point out to another. Suppose you are studying the effect of fertilizers. Misjudgment in the way the plants are topped or in the time of harvesting may result in marring completely the effects of the different fertilizers on the quality of the wrapper leaf. No certain judgment of the results of an experiment on tobacco can be made until the crops to be compared have been fermented and made ready for the manufacturer's use.

The appearance of the crop when it is cured in the barn and as it is sold to the dealers who sort and ferment it is often very deceptive, as buyers know to their cost. Some crops greatly improve during fermentation; others fail to meet reasonable expectations. Cigar leaf tobacco is a finished product—cured, fermented, cased, and subject to no further change, unless the slight change of "aging," till it is manufactured. Before it reaches this condition all is uncertain and insecure. Anything may happen to it. Therefore, it is unsafe to draw conclusions regarding an experiment until the crop is ready for delivery to a manufacturer of cigars. The experimenter must see it safely through the fermentation. Who is to judge of the quality of the leaf and by it of the results of the experiment, and how is he to do it?

What do we mean by quality? We mean fitness to meet the present tastes of the manufacturer of cigars—nothing else. His taste is in time governed by the whims of the smoker. To illustrate: Years ago the "trade," i. e., smoker, wanted dark-colored wrappers, the darker the better. Those who had rather heavy tobacco soils could readily meet the demand. Those who had light sandy lands used animal manures to darken the leaf, resweated the crops to further darken them, and even dyed the cigars. At the present time, on the other hand, cigar leaf, to meet the demands of the trade, must be light-colored, cinnamon brown, and dark color, once a point of excellence, is now a serious defect.

Both things are irrational. A very light leaf is likely to be imperfectly fermented; a very dark leaf is very likely to be unripe and evil flavored. A well-fermented, perfect cigar-wrapper leaf may be either moderately light or almost black. But however irrational, the demands of the trade are the only thing to be considered, and we must judge of our experimental tobacco crops solely by the measure in which they satisfy those who trade in tobacco. It follows that dealers in the leaf are the ones best fitted to pronounce on the quality of our experimental crops. But the request to act as judge in this way must be presented to them strictly as a business proposition.

Dealers are constantly receiving small samples of freak tobaccos for their opinion, and are not always overcareful in their statements regarding these casual visitors. Last year the writer had occasion to send samples of filler leaf to a number of firms, with whom he had no previous acquaintance, with a request for an estimate of its value. These estimates ranged from 7 to 35 cents per pound.

For five years the Connecticut Station carried on experiments with fertilizers, each plat of tobacco covering one-twentieth of an acre. Every winter we had thus about thirty lots of fermented cigar leaf to be examined and graded. We employed a man who was an extensive dealer in Connecticut leaf tobacco at a price which paid for the service, and he devoted each year more than two days to the work. Each sample was tested as to its burning quality, and particulars were noted regarding its size, color, stem, texture, grain, vein, burn, etc. This done, the samples were arranged in order, the best in quality being first and the poorest last. Each sample was in the beginning marked, for identification, in a way which gave the judge no clue to the plat from which the sample was taken. This method of judging of the leaf and by so doing judging of the effects of the method of fertilization has seemed to us the best that we could devise. It all depends on a single individual judgment, to be sure, but that judgment is a trained and an unbiased one.

And, lastly, what of the effect of experiments in growing tobacco on the farm practice of the tobacco-growing districts?

The farmer is conservative, extremely conservative. And to live as he does, surrounded by self-appointed guides who cry "Lo, here!" and "Lo, there!" to him, he must be conservative or utterly fail. The tobacco farmer knows that by following the methods of fertilization, culture, and curing which have been tested by a hundred years' experience in this valley he can, taking one year with another, make a fair living. He knows, too, how small a thing may damage the quality of his crop. He knows he can not afford to take the risks of anything at all doubtful in the way of experiment.

When the experimenter has, as he believes, demonstrated fully the advantage of some plan of fertilization or method of culture, or improvement in the way of curing, let him not therefore expect to find it at once adopted by intelligent growers. It will not be. Such a finished demonstration is not a fruit—something achieved for the grower; it is rather, if it is quite striking and conclusive, a seed planted in fair

soil, which, if all things are propitious, may some day spring up and bear fruit in agricultural practice.

Some two or three growers will be attracted by the results. In a few years they may try the thing on a very small scale. If they are pleased with it, they will perhaps modify their farm practice little by little to conform with the new notion, and little by little their neighbors will copy them. I know farmers have been quick to adopt the practice indicated by experimental work in some department, and something like a revolution of practice has been quickly wrought; but in other departments, and certainly in tobacco work, I have seen the benefit coming first in increased attention to the reasons, the philosophy of their practice, and then in a very slow change from present methods to others which were better.

In conclusion I may be permitted to briefly outline the work which the Connecticut Station has done and is doing for the tobacco interests of this State. More than 8,000 acres are yearly planted to tobacco, and the crop annually brings to our farmers about $2,000,000.

In 1892 a considerable number of growers organized the Connecticut Tobacco Experiment Company, bought a field of 3½ acres well suited to the growth of tobacco, in the center of the tobacco region, put up a curing barn, and asked the station to cooperate in experiments on the use of fertilizers.

A series of experiments was planned, not altogether such as the station alone would have suggested, but rather a compromise, and the management of the crop was put wholly in the charge of an experienced tobacco farmer, who was paid a salary. The crops were the property of the company and the station, the income being used to defray the expense of the experiments, any excess of expense being met by the station. About 30 plats were laid out, separated by a 4-foot path, and the various fertilizers and combinations of fertilizers were applied to their respective plats for five years in succession. The crops from each plat were marked at harvest, weighed after curing, and after being fermented in the warehouse of a tobacco dealer were graded by him according to quality, as has been already described. When the five-year term was concluded, the results of the series were collected, tabulated, and discussed.

Next followed three years of experimenting on the use of artificial heat in supplementing the usual method of curing, and particularly in protecting the crop from the dreaded pole burn during the cure. In the first year our barn and experimental crop was totally destroyed by fire.

For the last two years we have been experimenting, in cooperation with the Division of Soils of the United States Department of Agriculture, in two directions. First, we tried, on a commercial scale, to ferment our wrapper-leaf tobacco in "bulk"—i. e., in a large heap, instead of in cases, the method at present almost universally employed—in order to secure better control of the process and its results, and also to shorten the time required from six months or more, needed under the old process, to six weeks, which is all the time needed for fermentation in bulk; and, secondly, realizing that the character of the wrapper leaf at present raised in our State, while it commands a higher price than any raised in the Northern States, does not perfectly meet the demands of the trade, we have this last year experimented in raising Sumatra tobacco in the open field and also under a shade made of thin cheese cloth. We have had a third of an acre under this closed cheese-cloth cover, the top being 9 feet from the ground, and the plants grow up to the cover and then bent over, many of them being 10 or 11 feet high. This crop is now in the bulk undergoing fermentation. If any are interested enough to make the trip to Poquonock in the northern part of the State to take a look at it I shall be glad to go with them on Friday.

W. M. Hays, of Minnesota, suggested that a thorough system of breeding experiments with tobacco would bring out some very interesting facts in regard to the chemical relation between the quality of the product and the kind of soil.

W. A. Henry, of Wisconsin, called attention to the disagreement of experts in grading tobacco.

E. H. Jenkins gave some data regarding the cost of tobacco growing.

A paper by M. A. Scovell, of Kentucky, on Burley tobacco was then called for.

M. A. Scovell. Burley tobacco, gentlemen, as some of you know, is not a smoking tobacco. In a great many respects it is altogether different from smoking tobacco. The method of curing is different, that is, in curing it is not put under fermentation at all. Burley tobacco has proved so valuable to Kentucky that it is thought it might grow elsewhere in the United States, and therefore a description of it will not

be out of place here. What I have to say to-day is based almost entirely on my own observations, which have been quite extended in the blue-grass region of Kentucky and the bordering counties of Ohio where it was discovered.

The paper presented was as follows:

Burley Tobacco, Its Growing and Curing.

The best methods of raising White Burley tobacco, and the proper way to house and cure it, are matters on which the raisers do not agree. It is known, however, that the soil on which the tobacco is raised, the weather, the time of harvesting, the method of cutting and housing, all have their influence in perfecting its color, its glove-like handling qualities, and its pleasant peach-like aroma, which reaches its perfection after fermentation.

The statements made below as to raising and curing White Burley tobacco are not alone based on personal observations or experiments, but are in the main based on the opinions of intelligent and extensive raisers, buyers, and manufacturers of this variety of tobacco. Especially am I indebted to Mr. Walker, president of the Blue Grass Tobacco Company, who has allowed me to thoroughly inspect every process the tobacco goes through from the time it is taken out of the hogsheads until it is made into plug, twist, or smoking tobacco.

Although White Burley tobacco is used more largely in domestic manufacture than any other variety, yet it is, comparatively speaking, a new variety. It might properly be said to have been discovered, for it is said to have originated from a few white plants found in a red Burley seed bed in Brown County, Ohio, in the sixties. These plants, after transplanting, remained white until nearly half grown, after which the leaves began to show a greenish cast, and on ripening, they turned to a straw-yellow color. The midribs and stalk remained white throughout their growth. Seeds from these plants were saved, and from these the White Burley was developed. The bright, attractive appearance of this variety; its thin but tough and kid-glove-like handling qualities; its mild, attractive, peculiar, nut-like flavor, attracted the attention of manufacturers. The best qualities at once became very popular for use in the manufacture of fine-cut tobacco. The lower leaves made a granulated smoking tobacco of mild, but rich flavor. To-day it is used more largely in the manufacture of "Navy plug" and twist chewing tobacco than in any other way. This is on account of its great absorptive power for sweets and flavors. The best Burley tobacco can absorb as much as 40 per cent of its weight of sugar and flavoring extracts.

On a rich blue-grass soil 2,000 pounds of White Burley can be raised per acre, and if the season is favorable and harvesting and curing have been properly done, the crop should bring, according to the present demands, from 6 cents to 30 cents per pound, the price depending upon the position of the leaves on the stalk. The lowest leaves, called the flyings and trash, used as smoking tobacco, should bring about 6 cents per pound; the bright lugs, the next two or three leaves on the stalk, from 8 to 12 cents per pound; the bright leaves above the lugs from 16 to 30 cents per pound; and the red leaves from 12 to 25 cents per pound. In a good crop there are more bright and red leaves, by weight, than of trash, lugs, and tips. Where tobacco is topped high, the topmost leaves do not ripen fully and are not thoroughly developed when the plants are cut. In such cases these leaves are dark and bring only about 8 cents per pound. The prices above quoted are for the best qualities for the respective tobaccos. For inferior White Burley tobacco there is little demand, except at a very low price. A good crop will often bring over $200 per acre. A poor crop may not bring $50 per acre. There are many influences, any one of which may determine the difference between $200, or say a net income of $150, and no gain at all, but even a loss. Perhaps the soil has the greatest influence of any one thing in determining the quality of tobacco, and especially is this true of its color. New land is the best possible soil for White Burley tobacco. On such a soil maximum crops can be raised of a very bright color, fine in quality, and containing the largest proportion of bright leaves. Soils enriched by clover are the next best, but the proportion of red leaves to bright is greater in clover soils than blue-grass sod soils. The yield is fully as great, if not greater, on clover-enriched soils, and, generally speaking, the tobacco contains more gum, but does not cure up with as fine a flavor. Soils fertilized with barnyard manure make too rank and heavy tobaccos to be classed with White Burley, and they do not cure up well. Fairly productive soils, enriched by artificial fertilizers, produce a good quality of Burley tobacco. Experiments at the station tend to show that on such soils nitrate of soda, when used freely once or twice during the rapid growing season, produce a much brighter-colored tobacco than without such fertilizer.

The season has a marked influence on the quality of Burley tobacco. A very wet season makes a trashy tobacco; and it contains less gums and oils, and cures badly, that is, without the peculiar aroma. The very best season is one in which the rainfall is just sufficient for a full growth of the crop. A long dry season which tends to ripen the tobacco prematurely, followed by wet weather after the tobacco is nearly ripe, is very injurious, as it causes a second growth, which causes the leaves to cure up with a greenish cast and a very unpleasant flavor. A dry ripening season, with heavy dews, produces the finest flavored and heaviest bodied tobacco grown.

The time of cutting has its influence on the quality of Burley tobacco. To produce the best quality it must be thoroughly ripe. When cut green no process of curing can give it its peculiar flavors. The manner of cutting and housing has a great influence on the subsequent curing of the tobacco. In order to obtain the best quality, White Burley tobacco should be cured on the stalk; that is, the stalk should be cut and hung on a stick with the leaves on it. If the leaves are pulled from the stalk and hung in the barn, they dry up rapidly, or at least are trashy when cured, and do not develop, in subsequent fermentation, the nutty flavors so characteristic of good Burley tobacco.

CURING WHITE BURLEY TOBACCO.

As White Burley tobacco is cut the stalk is split nearly to the bottom with a peculiarly-shaped knife and then put on a stick 4 feet long, which is stuck in the ground by the side of the tobacco stub at an angle of about 45 degrees. Five or six stalks are put on each stick. The tobacco is allowed to wilt on the stick before it is moved; then it is either put on a trestle in the field or hauled immediately to a tobacco barn and hung up. A tobacco barn 20 feet high, 40 feet wide, and 72 feet long will hang from 5 to 6 acres of tobacco. The interior of the barn is so arranged that the sticks can be easily placed on rails, beginning at the top, coming down in tiers to the bottom. In hanging tobacco care must be taken not to place the sticks too close together; otherwise the tobacco will "house-burn." The sticks should not be placed closer than 10 to 12 inches. The barns usually have openings on either side about a foot wide and extending from the bottom to the rafters. These doors are on hinges, which can be closed or opened at will, and are about 12 feet apart. Sometimes ventilators are put in the roof, but this is not usually the case. If the tobacco is hung in the barn during a warm, damp season it is very likely to "house-burn," and a barn constructed as above does not give enough ventilation. The result is that some seasons a great deal of tobacco is house burned. No artificial heat is used in the curing of Burley tobacco, except at times a little charcoal is burned in barns during damp, warm weather to prevent house burning, but the manufacturers tell me that they can distinguish between tobaccos charcoal burned and those naturally cured. It is the opinion of manufacturers that White Burley tobacco should be cured slowly. If the weather is too hot and dry the ventilators should be closed; otherwise the tobacco dries up rather than cures. Such tobacco has a greenish cast on the under side of the leaf and fails to produce that peculiar, pleasant aroma when fully cured. Artificial heat in the barns produces the same results. It is claimed that by slowly curing the sap from the stalk enters the leaf. It is a fact that the leaves cured on the stalk slowly are heavier and gummier than when cured off of the stalk. If the peculiar aroma is produced by oxidization of the oils, etc., in tobacco, it would seem that light would have its influence in curing it. It is the general opinion of farmers that tobacco cures better in open sheds than in barns where ventilators alone are used, and that the tobacco on the outside and exposed to the light is of a better quality than that on the inside, provided always that the weather and wind do not mechanically injure it. The time the tobacco remains hung up in the barn has its influence on the quality. If stripped and packed in hogsheads as soon as dry it rarely develops into the best quality of tobacco. It should hang up long enough in the barn to go in and out of "case" several times. Freezing it after it is thoroughly dry is said to assist in bringing out the best flavors. When it is cured and in proper case a portion of it is bulked down in the barn. Bulking is piling the tobacco, in order that it may retain its case. This case can be produced artificially by supplying warm vapor into a closed room where the tobacco is hanging. The raisers of the Burley depend on the natural condition of the atmosphere to produce the case, and in order that the cured plant may retain the case until it is stripped it is taken off of the stick and placed in piles, which are covered with straw, fodder, or some material to keep the air from the pile. If, however, the plant just cured is allowed to remain in the bulk for a longer period than fifteen days, or when the temperature of the atmosphere is above 50° F., the pile will heat and the leaves become what is known as "funked," which deteriorates the quality of the flavor. A winter bulk is generally made long and narrow, about 5 feet high, the width of two stalks with the butts out, with a row of plants

overlapping the middle. From this pile the tobacco is taken to be stripped, and, when stripped, tied into hands containing not more than fourteen leaves, which are hung again into the barn.

The majority of the raisers sell the crop as soon after stripping as the leaves can be had in a condition to be handled again. The tobacco is put into hogsheads, which, by means of a press, are capable of holding from 1,000 to 2,000 pounds, according to the quality of the tobacco. It is then shipped to the market and sold to the tobacco rehandlers, who take it from the hogshead and again hang it, in order that it may finish the ripening process.

After the freezes and thaws and the damp and dry winter and spring atmospheres have acted upon the hanging leaves they become more set in color, and their oils give an aromatic flavor, and are ready to be manufactured. When it has thus ripened and is brought in case by the atmosphere of the early summer dews, it can be rebulked or packed into hogsheads, and will keep thus bulked for any desirable length of time.

When Burley tobacco has been properly ripened it gives an odor similar to that of a dried peach, and this flavor can be added to by bulking it in the right condition after it has ripened, or deteriorated by bulking it into too high a case in the winter or leaving it bulked during a warm temperature before the leaf has ripened.

Sometimes the rehandler artificially heats his redrying room and puts the tobacco in "summer case" in the winter time, but artificially ripened tobaccos are not of as high order as natural-cured tobaccos.

In reply to questions, Director Scovell explained the variation in the size and quality of leaves, the influence of soil and fertilizer on the tobacco, the form in which the tobacco is marketed and manufactured, the market demand, the source of supply of seed, etc.

W. M. Hays, of Minnesota, called attention to the importance of improvement by breeding.

M. Whitney, of the United States Department of Agriculture, spoke on the work of that Department in connection with tobacco, as follows:

Mr. Chairman and Gentlemen: The Department of Agriculture has taken up so many lines in tobacco work, and has started such a thorough and systematic attack upon the subject that it will be only possible for me to very briefly mention some of the lines of work and to say very little about the results.

A few years ago, in the course of our investigations, it became apparent that the conditions of the soil and climate in the Connecticut Valley were not very different from the conditions in Sumatra during the growing season; at least, so far as I could tell from an examination of soils, and from a study of the climatic conditions as we got them from the meteorological records, and from the character of the leaf grown there, I could see no reason why Sumatra tobacco could not be grown in Connecticut. Under cooperation with the Connecticut Station we have been laying our plans for this, until this year we have grown under shade a Sumatra leaf which the New York tobacco men can not tell from the imported leaf. If it is possible to produce economically this Sumatra leaf in this country it is going to mean a great deal for the agriculture of the country. We annually spend about $6,000,000 for Sumatra tobacco, and pay about $9,000,000 import duty on this leaf. The crop sells in this country for about $3.50 a pound, while the Connecticut tobacco brings from 20 to 30 cents a pound. It seems to me there is every reason to believe from results so far obtained that on some of the soils in the Connecticut Valley we shall be able to raise on a commercial scale Sumatra tobacco which is fully equal to that imported from the island. In the prosecution of this work we have worked with the New York tobacco men; realizing this fact, that if a farmer raises an individual crop in the Connecticut Valley, no matter how fine a quality it may be, it will have very little influence upon the commercial crop as a whole, because he himself is but a unit in the number who produce that leaf. The bulk of the crop of the Connecticut Valley is handled by a few large New York concerns. We have been able to interest them in the work and they have assured us, from the samples that have already been submitted to them, that if the work of the next season is successful they will see that the entire crop of the Connecticut Valley is changed, and they will undertake to produce all the Sumatra tobacco that is used in this country.

The Department also has taken up the subject of the Pennsylvania leaf, which is essentially different from the Connecticut leaf in that it is used exclusively for filler purposes—for the inside of the cigar. The Pennsylvania tobacco brings now about 7 or 8 cents per pound. The Cuban tobacco pays a duty of 35 cents per pound and sells for about $1.50 a pound in our market. From a study of soil conditions and climatic

conditions in Pennsylvania, so far as we have been able to interpret them, the Department has become satisfied that the Cuban type of tobacco can be closely approximated in Pennsylvania and in Ohio. It is our purpose, therefore, from the result of our soil surveys which we have undertaken this year, to determine the character of the soil that we shall try to work on, and another year if our plans are successful we will undertake the problem of trying to bring about a change in the methods that are now used so as to procure a superior crop with something of the aromatic flavor of the Cuban leaf in the Pennsylvania and Ohio tobaccos. Incidentally we found in Pennsylvania that there is an annual loss of about $1,000,000 from "black rot," which is entirely unnecessary and which is easily prevented. Our first work, in order to get the attention and the confidence of the tobacco people of that section, has been to send an expert to Lancaster in cooperation with the largest New York packers, who have freely given us their warehouses and their laborers and their own services to sweat the tobacco through the bulk method which is used in Florida and Cuba, and we have found that the 1898 tobacco, which failed to sweat by the case method, and which was badly damaged by black rot, has sweat finely by the adoption of the bulk method, and the growers see in that simple change in the method of handling the crop a saving to their State of thousands of dollars a year.

The Department has this year made a soil survey, similar to the Connecticut Valley, of about 250 square miles in the heart of Lancaster County, and of an area in the heart of the Miami Valley in the locality of Dayton, Ohio. It is proposed to continue this work and to considerably extend it from year to year, if Congress grants our appropriations, until there is a soil map of the important tobacco districts of the United States, which can be used by the growers in selecting land suitable for the kind of tobacco we want to produce, and which can be used by the dealers in looking for desirable commercial grades of tobacco. In addition to this work in the Northern States, the Department has been urgently requested to take up some work connected with the tobacco industry of Florida. The Florida growers are producing as fine a type of cigar leaf as there is in this country. It closely approximates, on the one hand, the Sumatra type for wrapper, and on other soils and by different methods of cultivation, and by different seeds, they are closely approximating the Cuban type of cigar filler, with a suspicion of that desirable aromatic flavor which gives peculiar value to the Cuban leaf. The growers, however, have found that they are unable to predicate upon the crop in any new locality. They may own an estate upon which the finest kind of tobacco was raised, and yet on an adjoining field the conditions are such that they are entirely unable to know what they are going to get. They think that such a survey as we made in the Connecticut Valley would enable them more thoroughly and quickly to extend their operations and to understand the capacity of their soil and the distribution or area of land which is adapted to tobacco culture.

In Texas also there is undoubtedly a great opportunity for a development of the Cuban type of cigar filler. Although the industry there is comparatively new, having as yet no place in the commercial world, yet we have had samples of tobacco from Texas which are superior in my judgment, and in the judgment of many of the New York men whom I consult, to anything that has been grown in this country for filler purposes. The crop as a whole is of little value, as the Florida crop as a whole is of little value, but the best growers who are giving careful attention to their methods of cultivation and treatment of the crop are meeting with excellent success. We are looking to Texas to produce very closely a Cuban type of tobacco with that peculiar aromatic aroma that we are all so anxious to get. It is proposed, if our means will allow, to make a soil survey in Texas as a basis for our tobacco work, for we believe that the area is limited and that the soil which is capable of producing the finest quality of tobacco can be readily identified. We are, however, making some preliminary investigations. If we are to go into such an undertaking as the development of the tobacco industry in Texas, we want to be as sure as we can of our premises. If we can develop the growth of a type of cigar leaf in this country having that peculiar and exceedingly pleasant aromatic aroma characteristic of the Cuban tobacco, it will be worth $5,000,000 or $10,000,000 a year to the State of Texas without any question. It is quite possible from what is already known that with the soil as it is there, and with the seed that we now use, and with the vast opportunities which are opening before us of plant breeding to fall back upon, that we shall be able to obtain this exceedingly desirable result in Texas, and it seems as though we ought to be able to produce there what has been grown heretofore almost exclusively in Cuba.

Now, right here, I am going to speak of a matter which will interest you all, and that is the difficulty of getting tobacco experts. I was peculiarly fortunate in being able to induce a gentleman to leave his business in Florida and take up this work in

the Department of Agriculture for the sake of the experience he would get in handling the Paris Exposition work and in the opportunities he would have of visiting different sections of the country and learning the methods; learning the character of tobaccos, the packing and quality of all the crops, and the people. I found, however, that it is a very expensive thing to get a properly equipped and properly trained tobacco expert. Men of his standing are getting now from $4,000 to $6,000 a year, and we find in the Department that it is impossible to keep these men unless we pay them at least $4,000 a year. We can not get assistants who have had the proper training to send down to Texas for less than $3,000 or $4,000 a year. The tobacco men that have had the special training demanded by the work of the Department are commercial men, with commercial habits and instincts, and the large tobacco houses pick them up. The tobacco packing houses are constantly in the market to obtain the best men they can get, and they are willing to give them what their services command. The Department can not expect to get men of equal ability for any less than they are giving. So the question confronts us now, what are we going to do to develop the tobacco industry when we are unable to get properly equipped tobacco experts for less than $3,000 or $4,000 a year. I am going to bring the matter to the attention of the Secretary, and see if something can not be done to induce Congress to make adequate provision in this respect. I am afraid that Congress will think it is a very big salary to pay a tobacco expert, but the Department is coming to find in all of the various lines, or in many of them which it has undertaken, that if we wish to obtain the best equipped men we will be obliged to pay the market rate for their services. If we want to get an expert truck gardener we will have to give $3,000 or $4,000. The truck farmers of Norfolk and the surrounding sections are ready at any time to engage men who are experts in this line at a salary of $4,000 a year, and give them a house to live in, a horse and buggy, and their vegetables. So also in the orange industry, and in the growing of roses and the production of greenhouse plants, the men who can handle these great commercial interests and make them successes are commanding to-day in the open market salaries of from $3,000 to $4,000 per annum. The salaries that are paid now in the Department of Agriculture are not at all commensurate with such figures as these. It is coming to be a question whether we shall have to let the tobacco interests go or whether Congress will allow us to pay the salaries that these experts can get outside and enable us to continue the work.

I presume all of you are familiar with Dr. Loew's work on tobacco. He was with us but a short time, but his work with us was like the passage of a brilliant meteor that has shot across our field of vision. He was with us but a few months. After he came to this country I induced him to go down to Florida, where they were experimenting in the fermentation of the leaf, to find out, if possible, the cause of the fermentation. It had been attributed to bacteria and other causes. He went to Florida, and I went down about ten days later and found that he had worked out the cause of fermentation. He found that it was due to the enzyms in the leaves and that bacteria had little or nothing to do with it. This opens up a large field and a large possibility of controlling this important operation in the handling of the crop. Undoubtedly the three enzyms found in the leaves have a certain function to perform in developing the peculiar aromatic flavor of the leaf. Cigar tobacco, as it hangs in the barn, can no more be compared with the finished product than can the leaf of a chestnut be compared with a manufactured cigar. The secret is in the fermenting of the pile. It is there that the aroma is produced or developed, probably from the destruction of some substance already in the leaf or from the production of some other substance. However that may be, it is in fermenting the leaf that the valuable qualities of the finished leaf are produced, and it is unquestionably due to the action of these enzyms that this quality is given. It has been a most unfortunate thing that the Department has lost his services just as the most important period of the work was opening up. He was called to Japan at a salary four times as great as the Department of Agriculture could give.

The Department has also taken an interest in the last few months in the selection of the samples for the Paris Exposition. We entered about 2,000 samples, representing all the commercial grades of tobacco raised in the United States, and made one of the finest commercial exhibits of the leaf which has ever been made. This included, of course, not only the cigar type, but the manufactured type and our cigarette type, and all of our export types. The exhibit was very favorably commented upon abroad, and it has greatly pleased the tobacco people, so that the Department is solidly in with the tobacco people of our country, and they are ready to do whatever they can to foster and assist in the investigations that are now going on. Two very interesting things were developed in the jury work. In the first place the Sumatra tobacco grown in Florida was awarded two points of excellence higher than

the imported leaf. It was recognized by the jury that it was more elastic and it was thinner, as it took twenty-five more leaves of the 16-inch length to make a pound of the Florida-grown leaf than of the native Sumatra, so we have beaten them two points on the very excellency which the Sumatra leaf has always claimed. Another very notable triumph for this country was in the award to the bright tobacco of the South. This was in competition in the jury room with the Turkish tobacco. While it was admitted that the Turkish tobacco had some excellence in flavor and aroma, it was seen on the other hand that the leaf was exceedingly small. It was not adapted to any other purpose than a filler leaf. It costs at least 50 cents per pound. That price is guaranteed to the growers by the Government. Our tobacco has a much larger leaf and is quite similar in its general characteristics. It is light, mild, extremely aromatic and with a very desirable flavor, and is not only well adapted for use in cigarettes, but for pipe smoking and chewing, as well as for high-grade cigarettes. Furthermore, it can be produced at a profit at 20 or 30 cents per pound. In consideration of these properties, which were admittedly superior to the Turkish leaf, the jury awarded the same eighteen points to the bright yellow of this country, as against eighteen points for the Turkish leaf. It seems to me that in these two cases the United States has scored two very important points which the commercial world freely admits and appreciates.

In closing I would say that the Department intends to start work in connection with expert tobacco lands and in the Burley district as soon as they are able to do it. It seemed best to take up the cigar leaf first. In many ways it is the more important, and it is very much more highly specialized, and we have pushed that as far as we have been able. We are still keeping at it, but just as soon as we are able we are going to start a soil survey of some of the other tobacco lands.

In response to a question regarding soil surveys, Professor Whitney said: "In our soil survey work we endeavor to observe any characteristic in the soil which is likely to have an effect upon vegetation. In the first place, we judge of the character of the soil in the field, and all of this work is done in the field. We do not rely upon our chemical or physical laboratory at all. We make the maps from actual work done in the field. This map, which you see hung upon the speaker's stand, was finished in the Connecticut Valley when the data from which it is made was gathered, and it was sent in that condition. We go into the field and map the soil as we see it. If it is loam, we judge of it from the way it is worked—from the way it is tilled, etc. Then we examine the subsoil to see whether it is a loamy subsoil, a clayey subsoil, or sand, or if there is any gravel in it, and it is a matter of examination and judgment altogether with us as to what class any particular soil goes into. Then we have to take account of the climatic conditions also."

The character of such work was indicated and illustrated by reference to a map of the various tobacco soils as found in the Connecticut Valley.

W. A. Henry. Do you think that having gone over a given region and distinguished the different kinds of soils and studied their characteristic differences you can go into another territory with the knowledge thus obtained and with your experience and tell better than a good tobacco man whether a certain region is a good tobacco region or not?

M. Whitney. Where they have developed the land in a small area there is no question at all but that we can, by a map classification of soils upon which tobacco has been grown, follow that out and show the distribution of those soils in the surrounding country. There is no question in my mind but that this can be done, and that it would be perfectly reliable. The physical character that we can see in many instances determines the distribution of these different grades of soil, and I would have no hesitation whatever in working out from an area which I understood into an area with which I was not acquainted.

W. A. Henry. We have large areas in the West which produce good corn, and in other areas immediately adjacent, which we have traced as far as South Carolina, and which by chemical analysis show all the elements of fertility necessary to that crop, and which, judging from that alone, would be classified as rich corn land, yet corn raised upon that land begins to die at 3 inches in height, whereas, in the regions

very near by, every variety can be produced, attaining a growth in some instances of 10 feet, and yet this land that I speak of adjacent to this good territory, is practically valueless for that purpose, and chemistry is unable to show the difference in the soils.

W. O. Atwater, of Connecticut, spoke as follows on "Available energy in food and body material:"

Available Energy of Food and Body Material.

What is available energy? is the question proposed on the programme. Will you allow me, in attempting to answer it, to give expression to some ideas which have been gradually taking shape in my own mind, and which I should be glad to see discussed by others who are interested in the metabolism of energy in the body and in the fuel value of food materials. For, unless I greatly err, these are among the coming subjects in the science of animal nutrition.

By available energy of food I understand that part of its energy which is or can be made available to the body. The same statement applies to the energy of body material metabolized.

Food has numerous functions, but its chief uses are the building and repair of tissue (to which may be added, of course, the formation of the fluids of the body, including milk and the digestive juices) and the yielding of energy. In supplying the body with energy food serves as fuel.

To make the subject clear, we must consider first the digestibility and availability of the nutrients of food.

digestibility and availability of food.

In order to make food available for use in the body it must be digested. The digestion is done at the expense of a certain amount of material which the food itself must supply. This material is essentially that which is poured into the alimentary canal in the digestive juices. That which is not reabsorbed remains in the feces, in the so-called metabolic products. These latter include also the fragments of intestinal epithelium and minute quantities of other substances. In addition, a small part of the food escapes digestion. The feces are accordingly made up of (1) metabolic products, which are mainly the residues of digestive juices, and (2) the undigested residues of the food.

This brings out the distinction between the terms "digestibility" and "availability" as they are here employed.

Digestibility.—This term is here used to designate the quantity or proportion of material digested. It is measured by the difference between the total food and the undigested residue. The same statement applies to the several nutrients, protein, fats, carbohydrates, and mineral matters. To determine the amount of each of these latter which is actually digested the total amount in the food and the corresponding amount in the feces should be determined and the latter subtracted from the former. The methods for distinguishing between the metabolic products and the undigested residues of the food, however, have not been made sufficiently accurate to enable us to determine exactly the proportion of undigested residue in the feces. Hence satisfactory determinations of the actual digestibility of food and of its several nutrients are as yet hardly possible.

Availability.—The term "availability" is here used to designate the quantity or proportion of the food, and of each of the several nutrients which can be used for the building and repair of tissue and the yielding of energy.

The metabolic products, which come from the digested food, are not used for either building material or fuel, and hence are not available in the sense in which the word is here employed. They represent part of the cost of digesting the food.

The amounts of available nutrients are found by subtracting the ingredients of the feces from the corresponding ingredients of the food. The term "digestible" has often been used in this sense, but the distinction here made is evidently an important one.

It may be that a better word can be found or coined to express the idea for which I am here using the term available. What I wish to insist upon is not the word, but the principle, namely, that we must distinguish between the material which the body can and that which it can not use for the building of tissue and the yielding of energy.

How the available nutrients of the food are actually utilized in any case—in other words, how much benefit the body gets from a definite amount of nutrients in a given diet—is another matter.

Total energy.—The total energy of a given quantity of food or body material is taken as equivalent to its heat of combustion in oxygen as measured by the bomb calorimeter, the unit of measurement being the large calorie. This assumes that when material is oxidized in the body the amount of latent energy which becomes kinetic and available to the body is the same as if the material were oxidized to the same or equivalent products outside the body, e. g., in the bomb calorimeter. The correctness of this assumption is based upon the belief that the law of the conservation of energy holds in the living organism, and is verified by the results of late experiments with men in the respiration calorimeter at Wesleyan University.

Available energy.—The energy which is potential in the food and body material becomes useful to the body by being metabolized to the kinetic form, as heat and mechanical (muscular) energy. The small amounts which are transformed into light and electrical energy in the bodies of some animals may be here left out of account. The kinetic energy is made available for various purposes, as (1) maintenance of body temperature; (2) the physiological work of circulation, respiration, digestion, and secretion; (3) other internal work of the body; (4) external muscular work. We need not here discuss the question of the transformations of energy by cleavage and synthesis in the body; nor is it necessary to inquire now just what proportions of the total energy metabolized are used for each of the various purposes of digestion, circulation, respiration, external muscular work, maintaining the warmth of the body, and other purposes, or how economically the energy is utilized for each of these purposes. The main point is that, in one way or another, the body avails itself of the larger part of the total energy for such uses, and the energy which is or can be so used is properly called "available energy."

Total vs. available energy of available nutrients.—Here, again, an important distinction is to be made. The total energy of the available nutrients is their total heat of combustion, while their available energy is the heat of combustion of so much of them as is oxidized or is capable of oxidation in the body. For the available fats and carbohydrates this available energy is the same as the total energy, because the fats and carbohydrates are completely oxidized to carbon dioxid and water.[1] With the available protein compounds the case is different, because they are not completely oxidized in the body. When the protein compounds are burned with oxygen in the bomb calorimeter to determine their heats of combustion, the carbon, hydrogen, sulphur, and phosphorus are completely oxidized, but the nitrogen is left free. When the same compounds are metabolized in the body the oxidation is not complete, because the nitrogen is left in combination with part of the carbon, hydrogen, and oxygen, in the form of urea and allied compounds, in which more or less energy is still latent. These unoxidized compounds are excreted in the urine. To find the available energy we subtract the energy of the unoxidized compounds from the total energy.

Available energy of protein.—It is not quite correct to assume that all the unoxidized (organic) matter of the urine comes from the protein compounds, but the error involved in this assumption is small, so that for practical purposes we may subtract the energy of this material from that of the available protein and consider the remainder as the available energy of the protein.

Gross and net available energy—Energy required for digestion.—We might go further and distinguish between gross and net available energy. The former would be the difference between the total energy of the food and that of the unoxidized material of feces and urine; in other words, the total energy of the oxidized or oxidizable material of the food. The latter would be the gross available energy, less the energy used in the processes of digestion, and would represent the net amount available to the body for other purposes. Since, however, the energy used in digestion is or may be still available to the body for the maintenance of body temperature, and in view of the lack of definite data concerning the actual energy cost of digestion, it seems best to use the term "available energy" to denote, as above, the energy of the available nutrients, less that of the unoxidized material of the urine.

Double use of energy in the body.—I have just referred to a principle which has been commonly neglected in discussions of the metabolism of energy in the body, namely, that when energy has been used for internal work it is still available as heat. This principle rests upon the fact that all the energy of internal work leaves the body as heat, a fact demonstrated some years ago by experiments of Rubner, and more fully by the later experiments here at Wesleyan, just referred to. The demonstration is

[1] There are, of course, exceptions, as when sugar is excreted by the kidneys in diabetes, or marsh gas is formed from carbohydrates by the agency of intestinal bacteria.

found in the two facts that internal, muscular, and other work is done, and that the energy given off from the body when the subject is at rest, or the sum of the heat given off and the heat equivalent of the external muscular work when he is at work, is equal to the heat of oxidation of the material oxidized. It follows that the internal mechanical work must be transformed into heat within the body. There is every reason to believe that this heat is as available as any other heat in the body for maintaining its temperature, provided it is needed for the purpose.

Economy of utilization of energy in the body.—In this brief discussion I have not entered into the question of the utilization of the energy of food. For instance, it seems reasonably evident that for the production of heat within the body the several nutrients may replace one another in proportion to their available energy. To put it in another way, isodynamic amounts of the different nutrients are equally valuable for heat production in the body. Whether the values of the different nutrients for the production of muscular work correspond with these isodynamic values or not is a very different matter. Certain late inquiries imply that, in some cases at least, a given amount of starch or sugar is more effective for supplying energy for muscular work than the isodynamic amounts of fats. For the fattening of animals or for milk production it would be very incorrect to assume that the practical values of the different nutrients are proportional to their isodynamic values. The experimental study of what may be called the productive values, as distinguished from the isodynamic values, of the different classes of nutrients from different food materials makes one of the most attractive and promising fields of inquiry for the physiological chemist of to-day.

FUEL VALUES OF FOOD MATERIALS AND NUTRIENTS.

The term "fuel value" is gradually coming into use and is evidently convenient and desirable. Unfortunately, there has been some confusion of meaning in its employment. For this latter I am ready to bear my share of the responsibility.

In the present state of our knowledge it seems to me that the best use of this term is such as makes it equivalent to available energy. With this understanding, the fuel value of a given amount of any specified food material or nutrient will be measured by the heat of oxidation of that portion which is capable of oxidation in the body. This is the sense in which the term "fuel value" has been employed in my own later writings, and, so far as I am aware, in those of the Office of Experiment Stations also.

DEFINITIONS.

The above considerations lead to the following definitions:

Digestibility.—This term is used to designate the quantity or percentage of a given amount of food, or of a given nutrient, which is digested—i. e., rendered capable of absorption, and, under normal conditions, is actually absorbed, from the alimentary canal.

Availability of material.—This term is used to designate the quantity or percentage of a given amount of food or of a given nutrient which is capable of being utilized for forming tissue and yielding energy. It is the total material less the corresponding material of the feces.

Availability of energy—Fuel value.—By this is understood the energy (heat of combustion) of the material of the food which is oxidized, i. e., capable of oxidation in the body. For the total food it is the total energy less that of the corresponding unoxidized materials of the feces and urine. For the protein it is likewise the total heat of combustion less that of the corresponding unoxidized residues of these excretions. For the fats and carbohydrates it is the total energy less the energy of the corresponding unoxidized material of the feces.

The Chairman. The subject is now open for further discussion, and we will be glad to hear any others who wish take part.

C. D. Woods. Mr. Chairman, I think we should be very glad to hear from Dr. Hagemann.

At the request of the Chairman, Dr. Hagemann, of Bonn, Poppelsdorf, spoke as follows:

I would say that there is a difference between energy required to digest dry foods and that required in case of wet foods, but it is not large. It is a difference, altogether, of about 5 to 10 per cent. We find that the dry food is more irritating in the stomach and in the bowels. Moist foods are reached more easily by the digestive liquid, and thus require less energy for digestion than dry foods.

Now, another thing—and this is a very serious matter—is the unit of power. It makes a great difference, in case of a horse, for example, as Dr. Jordan said, whether it travels rapidly or slowly. If it works slowly, the circulation of blood is not so great. If it works quickly, the circulation is much increased. We know by experiments with cattle made for this purpose that the speed of their work makes a great difference in the consumption of food. We have here circumstances similar to those in a ship. We know a small, slow ship burns only a few tons of coal, while the great steamer that travels much faster must burn two or three times as much, depending upon the increase in speed. Then there is the point that one cow may give a large amount of milk while another, with a similar quantity of food, gives only a small amount. I think that is due sometimes to racial differences. We also know that very often animals of the same race differ from each other, but this is especially true where there is a difference in race. Cows of different races give very different kinds of milk. The Jersey cow sometimes gives 6 per cent of fat in her milk, and the Holstein or Dutch cows give only 2 or 3 per cent of fat in their milk. Now, we may give both of them the same food, but we find that one will give 1 or 2 per cent more fat than the other. We do not know about these things yet. The most that we can say is that these differences depend upon the organic structure, which is essentially different in the two races. There are also differences due to breed, and these can not be explained.

Dr. Atwater referred to the experiments we have made in Germany on this question of energy. We have been making experiments thirteen or fourteen years and have found that there is a large amount of energy used up for preparing the food for digestion, and this should be deducted in estimating the available energy, or net energy. The amount to be so deducted is large, particularly in some coarse foods, such as hay. It is less in such foods as oats.

H. P. Armsby, of Pennsylvania. Mr. Chairman, there is one phase of this subject in which I am especially interested just at the present time, and that is the question of nomenclature. I can perhaps best illustrate the point which I have in mind by the figures of one of Kellner's recent experiments upon the metabolism of energy in steers. In this experiment the energy of the food and of the feces and urine was determined directly, while that corresponding to the hydro-carbons excreted was computed from their carbon upon the assumption that this existed in the form of methan. From the balance of carbon and nitrogen determined in the usual way the gain or loss of flesh and fat and the corresponding amount of energy was computed. The figures of one of these experiments, in which starch was added to the basal ration, were as follows:

		Calories.
Energy of food		38,562.4
Energy of excreta:		
Feces	9,843.8	
Urine	1,491.9	
Methan	3,183.9	
		14,519.6
Difference		24,042.8
Required for maintenance		13,921.8
Remains for tissue production		10,121.0
Energy of tissue gained		5,808.7

According to these figures, the total energy carried off in the excreta as potential energy was 14,519.6 calories, or nearly 40 per cent of the gross energy of the food. It is evident that the loss of energy in this way is relatively very much greater than with carnivorous animals or with man, and that results upon availability obtained

by experiments with those animals can hardly be applied directly to the food of the herbivorous animals.

Subtracting the potential energy of the excreta from that of the food, we have a difference of 24,042.8. This represents what Professor Atwater has called the available energy of the food. That is, it is that part of the energy of the food which either is or may be converted from the potential to the kinetic form in the body of the animal.

In the case of this animal it was known from previous experiments that about 13,921 calories were required for simple maintenance. Subtracting this, we have a remainder of 10,121 calories which could be used for tissue production. The tissue actually produced, however, represented only 5,808.7 calories, or 57.4 per cent of the total amount which could be applied to tissue building. In other words, 57 per cent of the energy not needed for maintenance was capable of being stored up in tissue, while 43 per cent of it assumed the kinetic form, presumably as heat.

Now, if we are to call all the energy which is not carried off in the excreta available, what words or combination of words shall we use to express that part of the available energy which can be converted into tissue, as in this experiment, or into work, if the animal is performing work? The natural thing would seem to be to say that in this experiment 57 per cent of the energy of food minus excreta was "available" for tissue production, but having used the word "available" in another sense we can not employ it with this signification.

I have myself been using a somewhat different terminology. I have called the total energy of the food "gross energy" and the energy of food minus excreta "net energy." Then I have said that of this "net energy" a certain proportion (in this experiment 57 per cent) is "available energy;" that is, it may be stored in the form of tissue. To put the matter in another way, the "net energy" would mean that portion of the energy of the food which is capable of being metabolized in the body—"metabolizable energy," if you choose—while "available energy" is that portion of the "net energy" which is capable of being stored as tissue or being liberated as work.

I am not at all wedded to these particular terms nor prepared to urge or even recommend them. What I desire to emphasize is the necessity for two distinct terms and the importance of agreeing upon some words which shall express the two ideas which I have outlined and which may aid in imparting clearness and exactness to our discussions of energy.

The subject was also briefly discussed by W. H. Jordan, of New York.

On motion of Professor Atwater, a committee was appointed to report at a future meeting regarding proper terms to be used in discussing this subject of energy in the living organism.

The members of this committee are W. O. Atwater, W. H. Jordan, and H. P. Armsby.

J. L. Hills, chairman of the committee on nominations, named the following officers of the section for the ensuing year: For chairman, C. D. Woods, of Maine, and for secretary, H. J. Waters, of Missouri. The nominations were ratified (see p. 85).

E. B. Voorhees, of New Jersey, then read the following paper:

Cooperative Field Experiments.

Field experiments with fertilizers is a line of work which possesses attractions for many experimenters, and is a very promising method of obtaining practical results. It is the farmer's method per se, and perhaps no line of investigation appeals more strongly to the practical man than this one, which takes to the field the theories of the laboratory and demonstrates their value and usefulness. It is, however, a line of work which possesses a great many difficulties, and one which, if not conducted with the greatest of care, is liable to result in conclusions that are not practical because not strictly scientific. It is evident from a thoughtful consideration of all of

the conditions involved that this line of work is not intended to be and can not be wholly scientific, and therefore is not a means whereby fundamental principles may be demonstrated and established. It is impossible, because of the variability of the conditions likely to occur, to control all of the disturbing factors which may enter in, which thus prevent the establishment of any fundamental law. The purpose, then, of work of this character must be of a secondary nature from the investigator's standpoint; or, in other words, if it is clearly understood that the object of the experiment is simply to verify, under the conditions that exist, the law that acts uniformly under controlled conditions, then the work may possess much of usefulness, of practical value, and in a sense something of scientific value; for it must be admitted that in the final application of definite laws the field or the crop is the final arbiter or judge, and it makes no difference from the standpoint of the practical man whether a law or rule is absolute under controlled conditions or not, provided it does not apply to his own conditions. Therefore, eliminating from our discussion the pros and cons concerning the scientific value of field experiments with fertilizers, and confining our discussions to the usefulness of the work from the practical standpoint, we shall, I am sure, find some matters of exceeding interest and worthy of our best thought. In the discussion of the topic I shall confine myself to the work that has been done in this country, and point out as clearly as possible what I believe the cooperation on the part of the farmer should consist of, if the results of the work are to have the widest application and be of the greatest usefulness to the greatest number. In the first place, it may be well to clearly define what I believe the position of the experiment station should be in the matter, and how far the work should be a cooperation with the farmer.

A careful review of the work of this character that has been done in this country shows that but a few stations have been prominent in it, and that it has in large part followed the general plan adopted by Professor Atwater previous to the establishment of the stations proper. Among these the station with which I am identified has probably done as large an amount of work as any, both in regard to point of time during which it has engaged in it and in regard to the number and kind of crops included. I may be pardoned if I draw more fully upon the reports of that station than any other in illustrating the points that I desire to make.

THE FARMER'S PART.

It has been my experience that the cooperation of the farmer should be limited almost entirely to providing the land, and I mean no disrespect to him. He may be honest and eager to furnish every facility for carrying it out, be accurate in his methods and in all his operations, still he can not be wholly depended upon, because his knowledge and training have not been of such a character as to enable him to clearly understand the necessity of absolute care in all details, and therefore may unwittingly destroy the usefulness of the experiment. Any real success or usefulness of work of this character will be in proportion to the extent of the direct and intelligent supervision of the station in charge. I add the word "intelligent" because I do not believe it should be delegated to the inexperienced assistant. This supervision should extend to inquiries; which shall establish facts concerning the previous treatment and cropping of the soil, and for a long series of years; the character of its subsoil, its drainage, its location, and all of these minor though important conditions which may unevenly influence the results that may be obtained. The supervision of the station should not stop here; it should be extended to the measuring of the land, to the applying of the fertilizers or manures, the planting of the crop, its cultivation, and the measuring or weighing of the final product. In fact, as before stated, unless the station extend its supervision in these particulars the results may be unreliable. Illustrations and examples could be cited which would still further verify these statements; but it seems to me that all interested will understand the importance of this position without further evidence. I do not mean to say that there may not be cases where the results are of value, when the experiment station acts simply as an adviser in the matter of cooperation, and this is not the exception rather than the rule, for in all these cases the results secured are limited in value and have a less comprehensive application.

Many of us, I am sure, can point to experiments that have been conducted under the supervision of the station where the farmer has been permitted to select this land, measure it, apply his fertilizers, and attend to the other details connected with the experiment, and has obtained good results which have been of particular value only to himself. Here it is not a question of results. The question comes upon whether the stations can afford to do work, or at least be responsible for work, the results of which are so limited in their application.

In the first place, it is important to clearly define in how far or along what lines the results obtained may be of service. In other words, results should not be regarded as valueless if they do not possess all the elements of value that may enter into work of this kind. The work possesses a threefold value: First, in its effect upon the farmer, experimenter, and thus establishing a center of educative influence; second, in verifying in practice fundamental principles or laws established by investigations in pure science; and third, in suggesting more rational methods of practice. I believe that not the least value attached to the work is that which comes to the farmer himself in an educational way. He is taught by this object lesson a great many things, the chief of which is, though it may not be so important now, particularly in the Eastern and Southern States, as it was when the stations were first established, viz: That plant food may consist of things of which he had no idea, and thus in an educational sense broaden and help the man. The educative work of this sort in a number of our States has been of the most useful kind. The farmer's prejudice in reference to commercial fertilizers has been overcome, and his knowledge concerning kinds and forms has been largely increased, and more accurately than could have been possible in any other way upon his farm; not that it could not have been possible by direct instruction at the schools. It is this sort of work which has lifted him out of the rut of empiricism and enabled him to base his practice upon a foundation of reason. This value can not be measured in dollars and cents.

In the second place, work of this character has been fruitful of great good because resulting in the establishment of economical and profitable systems of fertilization. It does not follow that all field experiments with fertilizers have tended toward the establishment of a definite and rational system of fertilization, but a careful survey of the character of the farming in the various States shows that this has been a most fruitful result. It is abundantly evident to anyone who has studied the development of the fertilizer business in the various States in which the consumption is considerable that in the early history of the business fertilizer mixtures were made to sell, and were not compounded with any regard to the possible needs of the crops in various lines of farming carried out. It was apparent that the manufacture proceeded on the principle that a fertilizer, to be a fertilizer, must simply contain one or more of the three elements, nitrogen, phosphoric acid, and potash, and that the usefulness of the mixture was not to any extent measured by the form of the constituents or the proportion of them existing in the material. It is also abundantly apparent to those same students that there has been in the past ten years a marked improvement in this respect. The average fertilizer now possesses more and better plant food than formerly, and I am satisfied from an experience of nearly twenty years of more or less intimate relations with both the consumer and the producer of fertilizers that this advantageous change has been brought about by the demands of the intelligent consumer, and that the intelligent consumer is a product of the work of the experiment station along these lines. He knows now the kind and character of the products that make the commercial fertilizer; he knows that there is a special function attached to the different elements, and that they do exercise a different influence in measuring the size of his crop and its value. I might give numerous illustrations to verify this point, but will confine myself to a very few, and those largely drawn from the experience of our own station. The first direct result of the field experiment work is the fixing in the minds of the farmers the fact that nitrogen, phosphoric acid, and potash in artificial forms are actually fertilizer ingredients, and may be quite as efficient and more profitably used in this form than in the form of natural manures of the farm. This has been a result of field experiments conducted in the various trucking districts of the State of New Jersey.

In 1891, for example, field experiments with fertilizers were carried out in two counties in the sweet-potato district. The primary purpose of these experiments was to find out whether artificial plant food would be as serviceable in the production of this crop as the city horse manure then being purchased in enormous quantities, and believed by the farmers to be the only manure which could be successfully used in the production of this staple. The results obtained showed very clearly that the commercial fertilizer was not only an actual fertilizer, but that it was a better one and a cheaper one for the production of this crop than the city manure, and the further result of this work has been not only to practically rule out the expensive city manure for this crop, but to cause a larger average yield than was obtained from the previous methods of manuring.

It must be admitted that the conditions were extremely favorable for the spread of the knowledge thus obtained. The character of the soil is practically uniform throughout the district, and the method of farming also similar, so that the results of these experiments were not subject to the variations that might occur if the soil upon which they were conducted had not been a representative one.

The advantages were, however, not limited to a knowledge thus derived, that fertilizers were actual fertilizers; it showed the farmer that there was something to learn of value, and incited a desire to know more concerning the management and fertilization of his other crops.

These experiments were cooperative, but the farmer only cooperated in so far as to furnish the land, which was selected by a representative of the station after a careful examination of the whole district suitable for the growth of this crop, and it was directly supervised in all details by the station. I have no doubt that if these details had not been supervised the results might have been very useful, but affirm that they would have been less useful, owing to the fact that there would have been less confidence in the evidence furnished by it on the part of the station, and thus causing a weak indorsement of the results in the publications or other means of bringing the matter to the farmers' attention.

Another illustration may be used, which has had its result in the fruit-growing district. A field experiment, begun as early as 1884, with fertilizers upon peaches, resulted in clearly demonstrating the fact that for this crop, which had not been regarded before as a farm crop, but rather a special one, closely akin in its management to a natural forest, the plant food applied in the form of commercial fertilizers was not only as good as that derived from yard manures, but was less expensive. It taught, furthermore, that this crop should be classed with other farm crops in reference to its needs for applied plant food. The results clearly demonstrated that a liberal use of fertilizers upon soils regarded as well adapted for peaches resulted not only in increasing the yields, but in materially lengthening the bearing period of the trees. This experiment, therefore, established a fact in the peach-growing sections, and its influence is apparent to-day throughout the entire State in the change of practice, and it has increased the profitableness of this line of farming.

All of these results, though widely useful, are not so because fundamental laws were established thereby, but because they verified particular phases of certain laws, and were further evidence of the fact that the usefulness of an experiment station is measured not only by the amount of investigation in pure science that is pursued, but by taking to the field the facts determined and seeing that they are put into practice and become a part of the everyday life of the farmer. It is, in a way, however, the determination and fixing of the working value of established laws when applied under practical conditions. As already pointed out, the fact that certain kinds of plant food will always act in the same way under certain controlled conditions is of no real service to the farmer. What he desires to know is how they will act under his conditions, which are modified by heat and cold, drought and flood, insects and diseases, and all the other modifying circumstances. When he, by work of this character, is brought to realize that there is reason in it, his respect for science increases and he becomes an eager and willing learner. The field experiments of a number of institutions have given a genuine uplift to the farmer, broadened his horizon, and placed him on a plane where reason rules.

Note the field experiments conducted by the Kentucky Experiment Station on corn, potatoes, and tobacco. The results have been strikingly useful in showing that potash was the deficient element, and should be used in abundance in the fertilizer applied. The application of this fact will result not only in a saving in the cost of plant food, but in making a unit's cost of it immeasurably more effective than if the facts demonstrated by the experiment had never been known.

The more elaborate experiments on tobacco by the Connecticut Station; the broad series of experiments on cotton by the Georgia Station; those of the New York on potatoes; of Delaware on forage crops, together with numerous others, may be pointed to as clearly demonstrating their usefulness to the particular lines of farming which they represent, and are of the utmost service in building up a higher intelligence on the part of the practical man. In our own station, field experiments with tomatoes, white potatoes, corn, and wheat have clearly resulted in the establishment of methods of practice which are far superior to those previously used, and are now almost universally adopted by the growers of these crops.

It must be remembered, however, that this cooperative work must be systematic, and planned in such a manner as to enable a study of its influence upon improved practice. As has been pointed out, the result of one experiment carefully conducted will influence and affect the entire work of one farmer, because it broadens his views; but experiments of an isolated character are naturally very much less useful than those which enable a consecutive and systematic study of all the crops that enter into a rotation. A point that must be impressed as far as possible by the experiment itself is that a method of fertilization which will result in the improvement of one crop has its effect, good or bad, upon those which follow in the rotation. Furthermore, it can not be too strongly emphasized that the results of a single

experiment may lead to radically wrong conclusions in reference to the value of a system of fertilization if, on the one hand, the interpretation of the results have been left to inexperienced investigators, and, on the other, that the relations to other crops have not been clearly pointed out. It goes without saying that experiments, to be of value, should be repeated often enough under different conditions of soil and season to enable the experimenter to arrive at an average that can be depended upon for practice. It should, moreover, apply to as wide a range of conditions and over as large an area as possible. Hence it is that experiments of this character in certain localities are more useful than in others, because the influencing conditions are more uniform. In the State of New Jersey, for example, the sweet potato, white potato, tomato, asparagus, and market-garden districts are peculiarly uniform, both in respect to the rotations adopted, character of soil, and in methods of management, so that a result obtained in one place will apply, with certain well-defined limitations, to all other places in that particular area. Now, this could not be true in some States because of the character of the surface soil; it is not uniform in reference to topography or in its chemical and physical composition and character, which renders it necessary in a great many instances to conduct experiments on not only different farms, but on different parts of each farm. In cases of this kind study of the physical characteristics of the soil shoud precede the experiments which would guide in their planning and have a bearing upon the influence of the results.

In summarizing, therefore, the following points should be insisted upon on the part of the station as prerequisites in cooperative field experiments, if it is intended that the results shall have the broadest application in practice:

(1) The station should assume absolute control of the work in all its particulars, the farmer cooperating only in so far as to provide the land and perform the necessary operations involved in the growing of the crop.

(2) That the greatest care should be exercised in the selection of the soil, choosing that which is as far as possible, both in reference to its previous cropping and its character, representative of a considerable area.

(3) The object in view in the conducting of the experiment should be clearly defined. It is better to include one or two points rather than a larger number.

(4) The publication of the results would better be withheld entirely, if the experimenter, with a full knowledge of the conditions involved, is not absolutely sure that the conclusions can be depended upon and verified.

C. S. Phelps, of Connecticut, presented the following paper:

Cooperative Dairy-Herd Tests.

One of the best ways to interest farmers in the work of the stations is to get them to experiment for themselves. Early in its history the Storrs Station began a series of cooperative experiments among Connecticut farmers. These experiments were at first mainly fertilizer tests, and not a few farmers of our State are ready to testify to the practical advantage this work has been to them. More recently a series of cooperative tests in the feeding of dairy herds has been undertaken. It is a summary of this work that I have been requested to present to you to-day.

The winter of 1892–93 the station commenced a series of studies to ascertain the kinds of rations in use by Connecticut dairymen and the amounts of milk and butter obtained from the herds where these rations were used. The first aim was to find out how our farmers were feeding in actual practice and then to get them to improve their practice if it did not agree with modern theories of scientific feeding.

Realizing that the ordinary methods of feeding were largely guesswork as to amount fed, it seemed best not to rely upon estimates made by the farmers themselves, but to send a man to the farms to weigh the feeding stuffs as they were passed out to the animals. Care was taken not to prejudice in any way the feeder. He was simply advised to feed each animal as was his usual custom, except that the feeds were passed over the scales and weighed just before being put into the mangers. A sample of each feeding stuff was also taken and sent at once to the laboratory for analysis. The only factor of uncertainty regarding the feeds was their digestibility. This could not very well be determined, and hence average coefficients of digestibility for similar feeding stuffs were employed in determining the digestible nutrients.

At first a large number of herds were studied for rather short periods (five days) in order to get a general insight as to the common practices of feeders.

Succeeding winters quite a number of herds were studied for longer periods (twelve days). The plan in these tests was to study the effects of the ration in use by the farmer on the milk and fat yields, and if the ration was one low in protein, to follow by another feeding period with a ration containing more protein, and to com-

pare the results of the two rations. The chief purpose in view was to compare the relative economy of rations low in protein, that were found in actual use, with rations containing more protein, that were proposed by the station. In most cases the proposed ration not only contained absolutely more protein, but relatively more. In general, then, the tests were comparisons of the economy of wide and narrow rations.

Incidentally these tests were of further interest to the dairyman by affording him opportunity to compare the relative productiveness of his cows, both as to yields of milk and of butter fat. A spring balance, graduated to pounds and tenths, was used in weighing the milk twice daily, and a hand Babcock tester was used in making daily tests of a composite sample of the night's and morning's milk of each cow.

Between the years of 1892 and 1897 thirty-two separate herds were studied and these studies included forty-five distinct rations. Fifteen of these rations were proposed by the station. The thirty-two rations in actual use by farmers varied in protein from 1.15 to 2.70 pounds, averaging 2 pounds, while the range in fuel value was from 21,150 to 35,150 calories. The nutritive ratios of the rations varied from 1:4.5 to 1:11.3, averaging 1:7.

For convenience in studying the relative profits obtained by these farmers in their feeding practices the thirty-two herds were divided into two groups according to the quantities of protein fed. Those herds receiving over 2 pounds per day per head of digestible protein were classed in one group and those receiving 2 pounds or less were classed in another. It so happened that the number of herds and the number of cows divided themselves about equally into these two groups. In the first group there were 16 herds of 226 cows, and the digestible protein per cow per day varied from 1.3 to 2 pounds, with an average of 1.62 pounds. The nutritive ratios varied from 1:6 to 1:11.3, with an average of 1:8. The second group also included sixteen herds that contained 227 cows, and the digestible protein per cow per day ranged from 2.1 to 2.7 pounds, with an average of 2.32 pounds. The nutritive ratios ranged from 1:4.5 to 1:7.3, with an average of 1:5.9. All but one of the ratios of the first group were wide, while most of those of the second were moderately narrow, ten out of the sixteen being below 1:6. The results obtained from these two groups of herds are easily compared as to yields of milk and of butter fat and as to the cost of the rations. Of course such a comparison is not entirely accurate, as it is made between two distinct groups of cows, and the conditions as to general management, stabling, etc., were not the same. Most of the cows, however, were of the same general breeding, more than three-fourths being pure-bred or grade Jerseys or Guernseys.

The group composed of herds that received 2 pounds or less of digestible protein per cow per day produced, on the average, 16.3 pounds of milk and 0.87 pound of butter per day, and the average cost of the rations was 14.8 cents per day. The group that received over 2 pounds of protein produced an average of 18.7 pounds of milk and 1.05 pounds of butter per day, and the average cost of the rations was 16.6 cents per day. This means that the herds, as a whole, that received over 2 pounds of protein produced, on the average, 15 per cent more milk and 20 per cent more butter than the herds that received 2 pounds or less of protein. Estimating butter at 20 cents per pound, the herds that received the larger quantities of protein gave the greater net profit, although the first cost of the rations was nearly 2 cents more. While such a comparison of results of two distinct methods of feeding, with different groups of cows, can not be said to demonstrate anything of scientific value, yet, considering the large number of cows in each group and the fact that they were largely of the same general breeding, the results are of some practical value as showing the advantages of rations relatively rich in protein.

In some of the later feeding tests thirteen of the dairy herds were studied through two feeding periods. In the first period a ration made up by the farmer was used, and in the second period one proposed by the station. The rations fed in the first period were usually low in protein and rather wide, while in those used in the second period there was generally a larger amount and a larger proportion of protein. In eight cases out of thirteen the total cost of the second or narrower ration was less than that of the first or wider ration, while in two cases the cost of each was essentially the same. In eight cases the cost of producing 100 pounds of milk, and in ten cases the cost of 1 pound of butter, was less when the herd was fed the second or narrower ration. One point that counts slightly against the actual showing obtained with the narrower rations is that the tests in which they were used were made considerably later than the tests with the wider rations. A natural shrinkage in production would be expected with an advance in the period of lactation. The second tests were usually made three to four weeks after the first, yet the herds, as a whole, gave as much or slightly more product when changed from the wider to the narrower rations.

In most of these tests the fact was made clear that the cost of the rations fed by Connecticut dairymen depended largely upon the proportion of the cheaper coarse fodders, such as corn silage, fodder and stover, oat hay and clover hay, which went to make up the roughage of the ration. The better market grades of hay were among the most expensive feeds used. The liberal use of nitrogenous grain feeds also tended to reduce the cost of the ration. A liberal proportion of these in the rations made possible the use of cheaper coarse fodders without reducing the efficiency of the ration.

Studies of this kind, that have now covered a period of eight years on forty separate farms, show that, notwithstanding all the efforts that have been put forth by two experiment stations to disseminate information regarding scientific methods of feeding, there is general lack of knowledge on the subject among Connecticut dairymen. It is true that some of our progressive farmers are making use of the teachings of the stations on this subject, yet the number that understand the meaning of balanced rations or who can calculate rations for themselves is very limited. A recent canvass of seventy-five patrons of one creamery in Connecticut has brought out the fact that only one understood the meaning of a balanced ration or tried to use such in his feeding practice.

One criticism offered against station workers is that they do not come into close enough contact with those whom they seek to benefit; that they do not bring their work home to the farmer in a form that he can comprehend and use. This, we believe, should be done not only at institutes and other farmers' meetings, but by cooperative tests in the field and stable, where scientific facts can be demonstrated before the farmer's own eyes.

C. D. Woods, of Maine. I think beyond question that such experiments have a very practical value. While they are not the highest kind of work, yet I believe they are exceedingly useful in bringing the theories of the stations into actual practice among the farmers. I had the pleasure of being connected with the Storrs Station a number of years ago, and I naturally take a little pride in the fact that these experiments have been conducted there. They are a practical demonstration to the farmers that by a change in the rations of their cows they can increase their value. Such experiments certainly have a distinctive value in showing the value of protein in the production of milk and butter.

While I would not class them with the highest order of work, yet I believe we can get out of such investigations things that are distinctively and decidedly of value. I think these experiments have indicated the value of nitrogenous elements in New England rations, and are not only of value to the particular men engaged in the experiment, but they are of value all over this State and even outside of it.

W. A. Henry, of Wisconsin. I want to express my appreciation of this work. I want that understood in anything I may say; but there are two or three things that I am not clear about. I wish to ask Professor Phelps whether those rations, the wide and the narrow, carry, as a rule, equal quantities of digestible matter? Do the cows that have the wide ration get as much digestible matter as the cows that get more protein?

C. S. Phelps. Very nearly. We calculate to keep those very nearly alike, although we do not make it a point that they shall agree, because we go on the theory that the protein is of prime importance.

W. A. Henry. I think this is a point which we have overlooked and which is of great importance, since there is a great difference in the foods that are placed upon the market. The question certainly has a serious bearing upon the efficiency of our stock. It is not only true of horses, but it is equally true of cattle. I believe that a hard-working cow, like a hard-working horse, can not do well upon a ration which contains much inert matter.

W. O. Atwater suggested that the influence of the nervous system on all of these problems is probably very great.

W. H. Jordan. We have been fixing our attention on protein alone, but we are learning that there may be very essential nutritive differences in the nonnitrogenous constituents of our cattle feeds, and in order to make feeding experiments logical we

must vary our conditions only in the points which we wish to test. To do that successfully in our experiments is not always an easy thing. I am quite in sympathy with experiments of this kind, but would exercise a good deal of caution in applying the conclusions to scientific questions. As to this idea of checking animals by sudden change in feed there is a great deal of misconception. For instance, we know that in some cases there has been a sudden rise of fat of milk. It has been fondly believed by some that they had fed fat into the milk. But they have generally found that they were mistaken and that it was due to the cow's normal, usual way of making it. The danger of concluding from short work is very great.

I appreciate what Professor Phelps has said, that there is a tendency to make the ration narrow; but I think we are not quite ready yet to say much about that side of the question. I believe we should give it a very searching investigation before we attempt to generalize about it.

I. P. Roberts, of New York. I am very much pleased with this paper. I think it is one of the most interesting that has been brought to the attention of the convention, and especially so for the reason that it treats of a case in which the experiment station has been brought in direct contact with the farmer, and has influenced his environment and method of work. Experiments of this character are certainly of great value. They get the farmer into the proper frame of mind. It makes an experimenter of him. An experiment station may try many experiments which demonstrate valuable facts, but an experiment station is of no value if the results of its work are locked up in figures. We have got to go to the farmer, and he alone must digest these results and put them into practice. I hope you will all live until the farmer has been raised to that point where he will appreciate the work that has been done for him. It is coming to that point, but it is coming gradually. That has been our trouble in the State of New York, but it is a trouble that we are gradually overcoming. We are gradually inducing farmers to act upon ascertained facts. It has been our policy in the State of New York to endeavor to bring the stations into close and active touch with the farmers themselves. We have gone to the farmers in the field, in many hundreds of cases, with a double object in view. Our first object has been to get the facts, and the second one to present those facts to the farmers, and I can conceive of no better way than by inducing them to become experimenters on their own account. We have been successful in this line in many instances, and have many friends among the agricultural population who are putting the results obtained in the station into practice. Many of them are reliable, and they are truthful, clear-headed, sensible men. A good many experiments have to be abandoned, of course. Some of those who undertake them prove to be careless, and in that case the results are not reliable, of course. But there are many careful, painstaking men among them, and an experiment made by the farmers in this manner is of far greater benefit than it is in the barn or grounds of the experiment station. It depends on the men.

I want to congratulate Professor Phelps in this matter, not only upon the persistency shown by the long line of experiments, but upon the results actually reached. I love exact scientific experimentation along exact lines, but I love the farmer more, and therefore I plead for the farmer.

C. S. Phelps. I would like to emphasize the fact that the station has had these experiments pretty well under control, on account of the manner in which they have been conducted. The farmers have been asked to use the feeds systematically and in accordance with general instructions which we have given. In most cases the work of sampling and weighing the feeds and the testing of the milk has been done by men whom we have selected and I have confidence in the result.

W. H. Jordan. Mr. Chairman, I, too, want to express my appreciation of this sort of work. The especially good feature in it is that it has been directed toward correcting what is a definite error in certain lines of practice. I might illustrate what

I mean by referring to an experiment which we tried on Long Island. I found upon Long Island, soon after going to New York to work, that the farmers were wedded to two things in their practice—the use of a ton of fertilizer per acre in growing potatoes and the use of fertilizer containing 10 per cent of potash. It seemed to me that there was a chance to illustrate by an effective experiment the advantage of a change in that practice in that particular locality. I wanted to determine whether the farmers would still continue to harbor their error in their practice when they were shown that better results could be obtained. We began a series of experiments with reference to those two points upon 12 acres of land located on four farms which were placed under our control. The experiments were essentially cooperative, because they were carried on by the farmers under our direction. Persons from our local office visited the work from time to time and gave necessary directions, and one of the farmers on whose land the experiment was conducted took especial pride in it, and was useful in calling the attention of the farmers in the neighborhood to what was going on. I am not going into the question of what we found, but I know that there has been a change of opinion on that matter in that locality, due to those experiments. It seems to me it is an admirable means of illustrating a good thing, and of showing the faults in some practice which may obtain among the farmers, and is deserving of our heartiest commendation.

I. P. Roberts, of New York, read the following paper:

Our New Agricultural Industry.

Civilization appears to create a desire for butter and sugar, particularly the latter. It is noticeable that the consumption of sugar by nations that are not highly civilized is very much less per capita than by those we may call the highly civilized nations. The following table illustrates this fact:

Consumption of sugar per capita for 1894-95.

Countries.	Pounds.	Countries.	Pounds.
Germany	26.78	Turkey	7.65
France	30.61	Italy	6.65
England	86.09	Russia	10.94
Average	47.83	Average	8.41

United States (1894–95), 62.60 pounds.

The great consumption of sugar per capita in England is due to the vast quantities of sugar used in the manufacture of jellies and jams for exportation. Just how much is used outside for ordinary culinary purposes can not be determined.

The total production of sugar of all countries for 1899–1900 was as follows:

Total production of sugar in the world, 1899–1900.

All countries.	Gross tons.	United States.	Gross tons.
Cane sugar	2,839,500	Cane sugar	132,000
Beet sugar	5,607,944	Beet sugar	72,944
Total	8,447,444	Total	204,944

In addition to the 204,944 tons produced in the United States the Hawaiian Islands produced 275,000 tons; Porto Rico, 50,000 tons; the Philippine Islands, for export, 40,000 tons; total, United States and her dependencies, 569,944 tons.

The normal exportation from the Philippine Islands is about 200,000 tons.

The United States produces 2.4 per cent of the sugar crop of the world, and the United States and her dependencies 6.7 per cent of the same.

The consumption of sugar in the United States for 1899–1900 was 2,040,676 tons, or 24.2 per cent of all of the sugar produced in the world. The United States imports 90 per cent of the sugar consumed and pays, in round numbers, $100,000,000 annually for sugar. In some years this equals the total receipts from wheat and flour exported.

When we consider the adaptability of the United States for beet-sugar production, it is found that the larger portion of our country is unsuited to the production of the sugar beet on account of climate or soil or moisture conditions. However, there are immense areas that are as well adapted to growing beets as the best districts of Germany or France.

Agricultural conditions are so different in America from those found in European countries that methods of production must be materially modified. It may be said that the American, if he is fully successful, will have to learn new methods of both tillage and manufacture. The American usually takes up new industries quickly and comprehends the salient points promptly. Already there are many farmers producing beets at profits far exceeding the profits realized in the production of milk, grain, grass, and even nursery stock. American ingenuity and American enterprise may be depended upon to offset the less liberally paid workmen of European countries.

The shiftless farmer will never learn to raise sugar beets profitably, and it may be said that we have many of this class; but scattered through all of the sugar-beet districts are found many men who have learned to apply rational methods of tillage and see clearly that the good tillage required for successful beet culture will eventually result in increased profits in the production of wheat, corn, and other standard crops. It is a notorious fact that wherever sugar-beet culture has been successfully introduced in the rotation, the yield of other crops has been greatly increased and the price of land augmented, sometimes as much as 100 per cent.

The real problem in the United States to-day is not whether there are enough acres suited to the sugar beet, but are there enough farmers of sufficient skill, thoroughness, and patience to make the cultivation of the sugar beet profitable and a permanent industry? The ordinary yield, which in New York is from 12 to 14 tons per acre, can not be taken as a standard to judge of the future industry, for some farmers are now securing 15 to 20 and even 25 tons per acre of beets which contain more than 12 per cent of sugar.

One hundred and fifty-two farmers who raised beets for the Binghamton, N. Y., factory the first season it was operated grew 250 acres, which averaged 14 tons per acre.

The question arises: Is there room for wide extension of the industry; and if so, what help are the experiment stations willing or ready to give to this great new farm crop? The number of factories in operation in the United States in 1899 was 34, with a combined capacity for handling 21,500 tons of beets daily. It will take more than 30 factories of the capacity of the one at Binghamton, or 20 of the capacity of the new factory just completed at Lyons, N. Y., to produce the sugar consumed by the people of the State of New York alone.

Nine factories were operated in the State of Michigan in 1899, and I am credibly informed that one milk-condensing factory in that State used more sugar in sweetening the condensed milk than all of these factories produced. If, then, we ever come to produce all of the sugar we require for home consumption and a surplus for export, what better way of disposing of it could be found than by selling it to foreign countries in the form of condensed milk? We should be following in a logical way the example of Great Britain, or rather be improving upon that example, for she has to purchase the sugar which is incorporated in jellies, jams, and the like, while we could easily produce all the sugar that would be needed for the milk-condensing factories. Here, as it seems to me, are two grand openings for the experiment stations—the combining of sugar with other products for export, and the production of sugar by our own farmers. I speak of the experiment stations taking hold of this work because the conditions in America, as I have said before, are so different from those found in Europe that all conclusions which have been reached in the last half century by France and Germany will have to be tested. It is probable that we shall find, as we did in the German maintenance ration, that what is true in a foreign country is not necessarily true in the United States.

In most of the States the areas suited to beet culture have been fairly well defined. This is a great point gained, as it will prevent the effort to raise sugar beets outside of the belt which is known to be well adapted to their culture. May I be pardoned for mentioning some of the questions which need further study.

First, the adaptation of varieties to different localities. We are now virtually raising but about two varieties. It will no doubt be found that in beet culture, as in wheat culture, each well-defined section will need a special variety. Some 200 or 300 varieties of wheat have been cultivated and each variety is grown in the best possible manner in a certain restricted area. So my thought is that there is a wide field here in the testing of varieties and in the originating of new varieties for the stations.

Again, the effects of different kinds of fertilizers and of different forms of the same fertilizer on the crop have not been certainly determined. In Europe it is said that sulphate of potash gives far better results than muriate, but all of the experiments in this country, so far as I have been able to study them, do not lead to the same conclusion. Muriate of potash seems to produce quite as good a quality of beet as does the sulphate, and is much cheaper. Some experiments, though they have not been carried on long enough to speak positively, indicate that much may be done to improve the quality of the beet by using certain kinds of fertilizers and that the yield may be largely increased without seriously diminishing the quality by certain kinds of farm manures.

Not enough definite experiments have yet been conducted to prove that subsoiling is beneficial in most cases. No information whatever is yet at hand in the United States to indicate what rotation will be the most rational when the sugar beet is brought into general cultivation. Some experiments seem to indicate that most of the fertilizing material had better be placed deep in the ground, and not near the surface. With other crops we come to the general conclusion that commercial fertilizers, at least, should be applied near the surface, but with sugar beets the indications are, though it has not been proven, that better results are secured by working the fertilizer well into the soil.

The value of refuse products of the factories alone should attract the attention of the experiment station. There are three by-products—the pulp, the unsalable refuse molasses, and the lime refuse. What are they worth to the farmer or the manufacturer? What can the stations do to help utilize these by-products? The molasses alone, produced in vast quantities, contains about 50 per cent of sugar, which can not be crystallized because of the presence of potash and other foreign substances.

There are also certain difficult problems arising each year in working the beets, growing out of different agricultural conditions, as different soils, climate, and different practices of fertilization. It may be said that nearly all of these problems have to do with the manufacturer rather than with the farmer. On the other hand, it may be said that if the by-products can be made useful the manufacturer can afford and probably will pay to the farmer a higher price for the beets than he could or would if the by-products were not utilized. The manufacturer and the farmer are so intimately connected in the production of sugar that to help one always helps the other. The experiment stations were certainly established to give aid and assistance to the farmer. Then it logically follows that if they can aid in introducing and perfecting a great new industry that gives promise of giving to the farmers in the sugar-beet belt $50,000,000 annually certainly the stations should take a lively interest in sugar-beet production. I have assumed that one-half of the $100,000,000 which has been paid annually in the past to other countries for sugar will land in the pockets of the farmers when we learn to produce enough sugar for the United States. It is probable that the other $50,000,000 will go into the pockets of those who manufacture the sugar machinery, the workmen in the factories, and the capitalists who furnish the means for erecting the sugar plants.

With a large number of efficient experiment stations in the land, all of which, I presume, are competent to aid in some way in stopping the annual drain of $100,000,000, equal often in value to the total exports of wheat and flour, are we not failing to do our entire duty to the nation unless eventually we stop this vast drain on our financial resources? These facts and suggestions are not given in any fault-finding spirit, but with the hope that the subject of sugar-beet production and of sugar in the United States may receive far more attention in the future than it has in the past. I trust that at no distant day the stations situated in the sugar belt may cooperate in their effort to solve the many unsolved problems of this new industry.

I. P. Roberts (in reply to a question by W. A. Henry). I will say very briefly that one beet-sugar factory has been in operation for a year in our immediate locality, another has been built this season, and another factory will probably be built next year.

B. Dyer, of London, England. At Rothamsted sugar beets have been grown with success for a great many years, and upon the same land provided the proper fertilizers were used. The largest crop ever taken from the soil has recently been harvested.

On motion of W. O. Atwater, seconded by C. D. Woods, the chairman was instructed to lay before the convention in general session a resolution of greeting to Prof. S. W. Johnson and of regret at his inability to be present at the convention (see p. 93).

T. S. Gold, secretary of the Connecticut State Board of Agriculture, was introduced, and spoke as follows:

Mr. President and Gentlemen: I allowed myself to be absent this afternoon in order to spend an hour with our old friend, Professor Johnson, the Nestor of agricultural chemistry in the United States, at his residence. I found him very comfortable, and passed a pleasant hour with him. He is not able to come out in this weather, but is still quite comfortable and happy in his home. I speak of him as the nestor of agricultural chemistry. Professor Johnson was employed by the State Board of Agriculture and by the State Agricultural Society in the early fifties to make analyses of commercial fertilizers in this State. His work was done here in the laboratory of the Sheffield Scientific School for a number of years, and the results of his labors were published at that time and were regarded as authority upon those matters. Later he was employed by the State Board of Agriculture to continue that same work. These are instances in the history of the work of the experiment station previous to the fact being known that there was such a thing as an experiment station among us. There are a very few people remaining among us familiar with the conditions and circumstances as they existed in those early days.

When we came to talk about an experiment station throughout the State we found some friends that were very powerful supporters of the idea, and prominent among them I recall that man of all learning, Elihu Burritt, the learned blacksmith, a man who was the most learned in all the languages of the world that we ever had in America, and, perhaps, in the world; and a man who, in his efforts to produce universal peace among the nations, stood before kings and queens and emperors and advocated the principles of universal truth. He was much interested in the subject. He was perfectly enthusiastic with the idea and with the work of the experiment station. It gave us a wonderfully good send off here in Connecticut to have him advocate the experiment station. We found others of a similar character, to whom this new idea was a matter of the highest interest, and with such men as promoters we were enabled to carry forward the work which resulted in the establishment of an experiment station in this State, and from that ultimately throughout the country. Professors Johnson, Atwater, and Brewer were the men that we relied upon here to bring this subject to the knowledge of the people.

I will not take up your time with any further reminiscences of these matters. I am very happy to have met you here and rejoice with you in the success of your work, and I thank you for your kind attention.

SECTION ON HORTICULTURE AND BOTANY.

Meetings of this section were held on the afternoons of November 13, 15, 1900, S. A. Beach, of New York, the chairman presiding.

In the absence of the secretary, P. H. Rolfs, of South Carolina, J. Craig, of New York, was made acting secretary.

The following paper, prepared by A. F. Woods, of the United States Department of Agriculture, was presented by W. T. Swingle, of that Department.

Plant Physiology in Relation to Horticulture and Agriculture.

The ground which plant physiology covers is pretty well defined in most botanical literature. There is a tendency for purposes of classification and division of labor to make arbitrary distinctions between the various phases of botanical study and we recognize these as necessary and helpful.

Morphology, anatomy, and physiology, as well as so-called systematic botany, are

each important aspects of botanical investigation, and in order to obtain a correct knowledge of the life of any plant it must be examined from all these points of view.

Each one of them includes to a certain extent all of the others. The general and special structure and morphology of an organism are just as much expressions of its life as is the production and storing of starch, they are therefore fundamentally physiological. For the practical purposes of this paper I shall consider *physiology* in its broader meaning as equivalent to biology, the study of the life of the plant in all its relations. The bearing of this study upon horticulture and agriculture must be considered from the standpoint of the practical farmer and practical horticulturist as well as from that of the teacher and investigator. The number of trained farmers and trained practical horticulturists is being rapidly increased through the excellent work of our agricultural colleges. We look to the men and women from these institutions who go from them back to the farms and nurseries to make farming a study and a profession as well as a means of subsistence. The botanical as well as the other training given has been repeatedly and carefully considered by this association with the result that an examination of the courses of study in the various agricultural colleges to day indicates a decided appreciation of the practical training necessary, especially in the various phases of botanical work. It is widely recognized that the general farmer should have a reasonably clear idea of the relationship, structure, and physiology of the representative groups of plants making up the vegetable kingdom, such as is given in a number of our text-books of botany, accompanied by a study of representative plants themselves. He should know something about bacteria, fungi, and algæ, as well as the higher plants. He should know something of the beneficial and harmful relations of bacteria, fungi, and algæ to higher plants, and learn in general how to guard against the harmful and promote the development of the beneficial species.

Having this knowledge he will know the reason for a great many rules and practices which the uneducated grower of plants follows in an unintelligent and automatic way, and knowing the reason he can vary the practice often to suit his special needs. He can keep in touch with and make use of improved methods of crop production and marketing. He will appreciate the experiment stations and the help they can give him and can cooperate intelligently with them. Some of these generally trained practical men are already cooperating with the experiment stations and the Department of Agriculture as observers and in carrying out field experiments, especially in the treatment of diseases of crops.

For the teacher and investigator it is of course recognized that the broadest and most thorough training is required. Some of the young men and women who come to our colleges will become teachers and investigators in some line of botany or horticulture.

It may be that in some colleges only the foundation training is possible. In others special training in some branch of the work can also be obtained. Those who want to prepare themselves for teachers and investigators may need to go to several places for post-graduate work. The teacher must be able to thoroughly appreciate, in case he is a specialist, the relation of other lines of investigation to his own. The physiologist who has no love for systematic botany, morphology, or anatomy is not thoroughly in touch with his science and will not be able to accomplish as much of value as the broader-minded student who turns all of these into physiology. The broadest botanical training should be encouraged if not insisted upon as a basis for special work either as teacher or investigator. For example, What is required of the physiologist in the practical work as a teacher or investigator? In the first place, he must have a clear idea of the genetic relationship so far as known of the representative genera of the vegetable kingdom; he must know their general anatomy, morphology, and physiology, including pathology. He must be familiar with their mutual and environmental relationships (ecology). He must know how to study plants by the most accurate and scientific methods from all these aspects. Then if he is to make the strictly physiological aspect the focus of his thought and work he will have to take this up in detail, and perhaps finally select some special problems, in the study of which he may become a master. Besides his biological training he will need a thorough knowledge of general chemistry, especially so-called organic and physiological chemistry; also of physics and geology, with special reference to soils and climatology. This is too often neglected by biologists with the result that they are unable to get down very far below the surface of biological investigation. This lack can not be supplemented, as a rule, by calling in a chemist or a physicist. It is the composite of these that is necessary to meet the demands of physiological work. Through all there must be a keen appreciation of the application of pure science to the great economic problems in horticulture and agriculture. There is just as much scientific value in studying the physiology of corn, tobacco, or

the sugar beet, with special reference to economic ends, as there is in studying some rare alpine or deep-sea plant of no economic importance, though facts obtained by study of the latter may be of scientific and practical value. A thorough knowledge of scientific German and French is also an absolute necessity, and a general college training is taken for granted. This is not an outline of an ideal training, but a conservative statement of the demands of the day. The Department of Agriculture and the State experiment stations want such men. It is easy to find partly trained men, but those with well-rounded training are scarce.

We quite agree, at least as far as physiology is concerned, with the opinion so often expressed at the meetings of this Association, namely, that the experimental work of the stations should not be left to men who have their hands full of teaching. It is helpful to the college and the station to be in closest touch each with the other, and both require men of thorough training and natural or cultivated taste, either for the college work on the one hand or the work in the station on the other. I am speaking, of course, for the botanical work, especially physiological botany. The various experiment stations under State and National control have already elucidated many problems in practical agriculture and horticulture, which are of the greatest importance to the farmer and fruit grower. It is the business of the physiologist of the station to see that those for whom he is laboring get the benefit of all improvements in crop production and marketing wherever they may be discovered, so far, at any rate, as they come within the scope of his work and can be adapted to his region. Take, for example, cereal culture. Only a few growers of wheat, oats, rye, and barley make any attempt to prevent the annual ravages of "smuts," though everyone of them, with the possible exception of corn smut, can be easily and cheaply prevented. It is also known that two serious leaf-spot diseases of the sugar beet can be controlled at little cost by spraying with Bordeaux mixture. The reduction in sugar content of the diseased beets is enough to make the difference between profit and loss in many cases, yet year after year the disease is permitted to develop. The same is true, though to a less extent, of the black and brown rot of the grape, the leaf blights of pomaceous fruits, peach-leaf curl, and numerous other diseases. The horticulturists, as a rule, are ahead of the farmers in the application of the results of scientific research to their business. These improvements can not be brought about simply through the publication of bulletins. The farmer must see the thing done before he can appreciate it and do it himself. This means lots of object teaching in many communities, and much careful supervision until the methods are well understood by a very large number of practical men, and they learn that it pays. Much of the station physiologist's work should therefore be on the farms and in the orchards of his State. In my opinion this personal work of popularizing what is already known is the work that most needs to be done for the next few years. The graduates of our colleges of agriculture will help materially in this, but they are at present too few to leaven the lump. Care must be taken that no student is sent out as trained in agriculture or horticulture who does not understand these things. I am sorry to say that in some cases college graduates who have taken the civil service examination in physiology and pathology as scientific assistants in the Department of Agriculture have failed on the subject of treatment of diseases. One answer to the question "What is the composition of Bordeaux mixture and how is it made and used?" may indicate how little is sometimes known of these subjects even by those who are supposed to know something about them. The answer was about like this: "Bordeaux mixture is a sauce made of mint, red pepper, mustard, and some other things I have forgotten, and when applied to roast meats is very appetizing." It may be that this young man had taken a course in cooking; at any rate, he had neglected to learn anything about plant diseases and their treatment. But while there are many who fail there are also many who show a very creditable knowledge of these practical applications of science to agriculture and horticulture. These men and women may aid the work of the station in a most decided manner.

The physiologist who keeps in personal touch with the industries he is endeavoring to help will come to understand their needs and solve problems that could never be understood or solved in any other way. Let us preach and do personal work.

It may be of interest now to briefly consider some of the more important problems demanding special consideration by investigators engaged in physiological work.

PATHOLOGY.

In pathology there is an almost inexhaustible field. Only a few of the more common diseases have received thorough investigation, and some which have been studied the most, like peach yellows and the California vine disease, are still unsolved problems. Others, like the Monilia fruit rots and the rusts of cereals and other plants,

still require much study from the standpoint, on the one hand, of the physiology and life history of the fungi causing them, and, on the other hand, of the causes of susceptibility and resistance in the host plant. No thoroughly successful and practical preventive treatment is known for either the Monilia fruit rots or the cereal rusts. The annual loss to the country from these two classes of disease alone is many millions of dollars.

It is in connection with this class of diseases especially that the securing of resistant sorts, either by selection or hybridizing or both, assumes great importance. When this work of breeding is backed up by the knowledge of the causes of resistance in the cases in hand the work of securing the resistant sorts with other qualities desirable will be simplified.

As an example of what I mean in this connection, permit me to illustrate from some of my own experiments. During the investigation of the so-called Bermuda lily disease we found that certain lily plants were very much liked by aphides, while others were avoided by them. The plants which the aphides liked and thrived on were very sensitive to their punctures, the tissues of the leaf reacting by the formation of a light-colored spot, the cells of which gradually died. These same plants were also found to be very sensitive to the work of the "bulb mite." At first the only constant difference observed, associated with this phenomenon, was one of a chemical nature. The sensitive plants were found to contain a smaller amount of soluble reserve albumens and a larger amount or greater activity of certain oxidizing enzyms, especially oxidase and peroxidase. This was also accompanied by a decrease in the tannin content, especially of the cells surrounding the vascular tissue, from which region alone the aphides draw their nourishment. It was further found that the increase of the oxidizing enzyms inhibited the action of translocation diastase, and consequently the formation and movement of sugars and reserve proteids, to the growing parts. It was then observed that these sensitive plants were, as a rule, of slower growth than the resistant plants and of somewhat lighter color, making it possible to determine by general appearance with some degree of accuracy what plants would be most and what least susceptible to injury by aphides. It is well known that aphides, as a rule, dislike tannin; hence the reduction of tannin, with the sluggish movement of reserve sugars and proteids in the plants rich in oxidizing enzyms, probably explains why these plants are liked by aphides. The pathological reaction in these latter plants also appears to be due to increased oxidation in the cells surrounding the puncture.

The plants which are not liked by aphides and which do not react to their punctures are rich in reserve proteids and sugars and tannins, and poor in oxidizing enzyms. The same was found to be true for carnations and other pinks and for a number of other plants investigated. It is thus possible to select resistant cuttings or seedlings even in the absence of aphides. The resistance may be increased by increasing the tannin content of the cells which goes with increased activity of the chloroplasts and the formation and translocation of sugars and reserve proteids.

The grape-growing industry of Europe depends on the resistance of the roots of the American vines to phylloxera. The commercial success of apples in Australia is said to depend in a large measure on the resistance of the varieties grown to the American apple-root aphis. There is a similar variation in the resistance of individuals and especially of varieties of all crops to insect and plant parasites as well as to adverse climatic and soil conditions. What is the explanation of this resistance, and how may it be maintained and increased?

The logical procedure is to find the cause of resistance and then proceed by selection and hybridizing to fix and increase it. In practice, however, we must, as a rule, accept the fact of resistance and proceed to select from this starting point.

Work of this kind is necessarily slow, but it offers great rewards for patient and intelligent investigation. The same may be said in regard to the whole broad field of the improvement of crops from all standpoints by breeding.

NUTRITION.

In the field of plant nutrition there are many problems of great economic interest demanding consideration by physiologists. The improved methods of determining the chemical and physical composition and structure of soils have made it possible to work out with greater accuracy the relation of crops to soil conditions, especially to moisture variations and consequent changes in salt concentration. Some of these changes produce pathological conditions, especially when the salt content is unusually high, as in the alkali areas. Some of the most serious root rot diseases in the Southwest, as, for example, in the Pecos Valley region of New Mexico, are apparently caused by the injurious action of too great variation in the salt content of the soils, thus weakening the roots and destroying the root hairs and young absorbing roots

and permitting the entrance to the tissues of root-rot fungi. The injurious effects of overirrigation and insufficient drainage require more thorough investigation from the standpoint of crops. It is well known that soil and climatic conditions produce remarkable variations in plants, but in many cases the physiological explanation of these changes has not been worked out. The remarkable variation of tobacco under different conditions is a case in point.

There is much to be done also in regard to the relation of different combinations of the various mineral nutrients and their character to the growth of plants and the quality of their products. Much more has been done in this field for tobacco than for other crops. There can be no doubt that the texture, aroma, flavor, and keeping quality of fruits is greatly influenced in this way, and great improvements in these regards might be made if these relations were understood.

Then there is the question of the control of the physiological activities of the plant not only by modifications of the soil and other environment, but by special methods of handling the harvested product. The problem of the curing and fermentation of tobacco, recently shown to be intimately associated with certain enzyms of the leaf, the presence and activity of which are necessary to the fermentation process, is a good example of what I mean in this connection. Much more needs to be done for tobacco, and similar work should be undertaken in the study of the ripening of fruits and their preservation. Why is it, for example, that certain varieties of pears and apples are improved by picking at a certain stage of ripening and keeping in a cool place protected from evaporation and air currents? Lemons and some other fruits are also known to be improved by a curing process. Very important results would most likely follow from careful investigation of these phenomena.

The more we can learn of the exact nature of the normal and pathological processes taking place in cells and cell complexes the better able we shall be to get control of these changes for the good of man.

B. D. Halsted, of New Jersey, was of the opinion that characteristics of varieties regarding susceptibility to plant diseases should be the subject of careful study and investigation. Why some varieties of vegetables and fruits are often immune to the attacks of fungus diseases, while others are commonly attacked, are questions difficult to answer. As a specific instance, asparagus rust was cited. Halsted found that Palmetto was much more resistant to rust in New Jersey than other varieties, and suggested that this immunity may be in part due to the heavy covering of bloom on the stalks of this variety; possibly, also, there may be a difference in the physiological make-up of the cuticle.

W. C. Sturgis, of Connecticut, suggested that morphological examinations of resistant and nonresistant varieties should be made. He cited the result of the morphological study of the leaves of fruit trees showing greater or less susceptibility to injury from the application of fungicides and insecticides. This study did not reveal any cuticular differences or any differences in the epidermal cells, but did show a marked difference in the character of the parenchyma. He found that the more spongy the parenchyma the more nonsusceptible was the variety to injury from insect and fungus sprays. This looseness of parenchyma tissue seemed to be correlated with strong resistant power to injury from copper salt and arsenical poisons.

W. T. Swingle stated that in an instance that came under his notice, where, in making Bordeaux mixture, lime was used greatly in excess of the exact quantity required to neutralize the free acid, little injury resulted when the mixture was applied to peach foliage. On the other hand, when Bordeaux mixture was made by the ferrocyanid-of-potassium test, injury often resulted. In breeding resistant plants the cause of the resistance is the thing to be studied. If a person is able to correlate with resistance some well-defined characteristics, it will be found of great assistance in the work of selecting desirable types.

F. W. Rane, of New Hampshire, emphasized the desirability in this experimental work of having all environmental conditions as carefully under control as possible.

T. A. Williams, of the United States Department of Agriculture, suggested that ecological studies were becoming more and more important in our experiments having for their object the improvement of the farmers' condition; and knowledge of the interrelations of plants is not only necessary to the investigator, but exceedingly desirable for the farmer.

E. S. Goff, of Wisconsin, then read the following paper:

Laboratory Work in Horticulture.

I have been asked to prepare an article on this subject, which seems to be a perplexing one to some instructors in horticulture. As an introduction, the following quotation, used at second hand in a recent number of the Pedagogical Seminary, is appropriate:

"Some fact in science is discovered and a man casually reads about it, or is told about it by a friend. He probably gains in this way a dim, far-away notion, and soon forgets all about it. Second, his friend takes him into his laboratory, sets up the apparatus, and demonstrates the discovery before his eyes. From this he gets a much clearer knowledge. His friend next places the apparatus at his disposal and lets him try the experiment himself; and his knowledge takes on a still stronger quality. It might be difficult now for him to forget the circumstances. Suppose, finally, the man works out the problem for himself; devises, possibly makes his own apparatus; works days and nights in meeting difficulties and overcoming obstacles, until at last he has his results definite and clear; until he has himself added a new fact to the sum of human knowledge. The discovery, the knowledge, has now become a living part of himself, an inspiration and a satisfaction as long as he lives."

This quotation is applicable, not so much because it clearly shows the value of laboratory work, which no one denies, but because it indicates two stages in laboratory work itself.

The first two steps indicated, viz, the telling of the discovery and the performing the work in the hearer's presence, we all recognize as the kind of instruction that the student receives in the lecture room. The last two, wherein the learner performs the work himself, belong to the laboratory.

In the first of these laboratory stages the student learns by imitation only; in the second he assumes, in addition, personal responsibility and finds out the way largely for himself. The second kind is much the better for the student, but it is the more difficult kind of instruction to give where students are herded, because it is often difficult to devise a sufficient number of profitable exercises.

Analysis of a subject always helps to understand it. In my own thought I have divided laboratory work into five divisions, with reference to its objects.

The first and simplest I have called "observation work." The student is given some kind of material for study for the purpose of discovering for himself certain definite, useful facts. The training of observation alone, without reference to useful knowledge, as is practiced so much in high schools in the so-called "nature study," is all right in its place, but it does not belong to college work. The ability of the instructor in this kind of work is shown by the choosing of the kind of material that will best demonstrate certain preconceived facts that it is important the student should grasp. If some useful secondary knowledge can be imparted at the same time, all the better. For example, every farmer should know that the potato tuber is a modified stem, and not a part of the root. To demonstrate this I have given my students each a shoot of young box-elder wood, including the apex, a few underground stems and a few roots of quack grass, and a potato tuber—a longish one is preferable. We first study the box-elder twig, noticing all the points we can about it, but especially the arrangement of the buds, i. e., that they are not directly above each other, that they are closer as we approach the apex, and that there is a leaf scar (or leaf) beneath each. Next we compare the quack-grass stems with this, so as to bring out their points of resemblance. Then we compare the roots of the quack grass with the stems, and bring out the fact that the quack grass propagates from buds on its underground stems, and not from its roots. This fact, which is always new to most students, is important, but it is incidental to the main point of the lesson. This comes out in the next step, which is to ascertain the points of resemblance between the underground stems of quack grass and the potato tuber.

In this division I have placed the study of clover and other seeds to learn the different kinds and grades, the study of germinating seeds, nodes and internodes, leaf and flower buds, cambium layer, flowers and their parts, plantlets of corn and other grains, germinating potatoes, and the morphology of the different fruit plants.

The second division I have called "method work," because its purpose is to teach certain methods that require little skill, but some knowledge of conditions and materials. In this division belong such operations as the testing of seeds and the compounding of insecticide and fungicide preparations. The aim has always been to have each student perform the operation himself. As the number of students has increased, however, this has not always been practicable. Two students working together employs a larger number and with nearly as good results. Where the num-

ber is too large I have been obliged to compromise by performing some of the operations in their presence and requiring them to make full notes of the work.

In this division, besides the operations noted above, I place the making of grafting wax, grafting paper, and grafting cloth; the testing of potatoes to determine their starch content; the treatment of grains to prevent smut, and of potatoes to prevent scab; the use of spraying devices, and how to keep them in repair; how to compute the dew-point and to foretell frost; the laying out of orchards, selecting seed corn, stratifying seeds, etc. In some of these operations, as the laying out of orchards, students may work in squads, provided there are assistants enough.

This division shades into the third, which I have called "craft work," because in this the student learns how to perform with facility certain necessary operations that require more or less skill to do them rapidly, as grafting, budding, setting strawberry plants, etc. In this division each student is required to perform the work, and, so far as practicable, all are required to perform it in the same way. The limited time at command often prevents giving the students the drill that I should like to give them. In root grafting I have found much help in using charts illustrating the principal movements. For making berry boxes and tree protectors I have usually written precise directions upon the blackboard and required the student to copy them before beginning the work. I have always had difficulty in having the students follow the directions, as some always insist on doing the work some other way.

The different methods of packing fruit, vegetables, and nursery stock come under this head; also covering plants for winter protection, hilling up celery, making hotbeds, pruning, tree planting, etc.

The fourth division I call "demonstration work," because in this I require the student to perform certain simple experiments, each of which is intended to demonstrate a general principle. For example, by placing an equal number of kernels of wheat into two shallow dishes, covering the kernels with water in one dish and only half covering them in the other, the student ascertains that wheat will not germinate without access to the air. Much of the work in this division would be more appropriate in a botanical than a horticultural laboratory, but many of my students have not taken botany, and most of those who have have taken little, if any, work of this kind.

In this division belong, besides the operation named, experiments in the absorption of water by seeds in compressed and loose soil, and in the same soil at different temperatures; the proof that seeds can not germinate unless saturated with water; the germination of large versus small seeds, plump versus shrunken seeds, fresh versus old seeds, mature versus immature seeds; the vegetation of clover and timothy and other seeds planted at different depths; the testing of tools, etc.

The fifth division I shall call "gumption work," because it is intended to throw the student more or less on his own resources. As an example, I require a student to write out a complete description of the heating apparatus of the greenhouse, giving him no hints on the subject except to say that the house is heated by steam which is generated at the heating plant in an adjoining building. He studies out the course of the steam through all its tortuous passages and the return of the condensed water to the boiler, putting the substance on paper either as a diagram or a written description. When he has finished he has a fair idea of one method of heating a greenhouse. For another lesson, I hand the student a copy of Gray's "Field, Forest, and Garden Botany," and say to him "There are in our plum orchard trees of five different species of plum. I wish to have you pick out one tree of each of the five species, and tell me which species each tree represents." When he has done this he is much better informed as to the species of plum than if I simply recite them in the lecture room.

It is this division that taxes the resources of the instructor most; but the operations, if wisely selected, are most valuable to the student. I give this kind of work only to my most advanced students, and I do not, as a rule, give the same work to more than one student at a time. If the number of advanced students were large, I should find it difficult to give all equally profitable work.

It is unfortunate that our students are usually all absent during the fruit-marketing season. One of the most practical lessons in this division would be the marketing of fruits, and I commend this to any instructors who have students during the fruit-marketing season.

Another division that might be made is in the line of true investigation work—i. e., stating to the student a definite question which has never been satisfactorily answered, as what causes apples to drop a few days after the petals fall, and ask him to find out all that he can upon the subject. Very few students are sufficiently advanced to accomplish anything of value in this kind of work.

In conclusion, I add that unless our college laboratory work in horticulture is very carefully planned its value to the student who expects to make his living by grow-

ing and selling horticultural crops is not likely to be great. Success in this calling depends more upon the grasping of certain broad principles of a business nature than in the mere learning to perform a few manual exercises that require a little skill. For example, it is far more important that the student should be drilled in the method of securing the best markets for his produce, and how to put it up so that it will command the highest price, than that he should learn how to nail up berry boxes rapidly, for he can easily hire this work done by the piece by those who can work far cheaper than he can. No instructor should feel bound to give his students a given number of hours of so-called "laboratory work." When some kind of manual work is more profitable to the students than any other exercise, give it to them, but avoid wasting time on petty operations that are of only incidental value.

B. D. Halsted, of New Jersey. Horticulture and botany are united in the department of which I have charge at Rutgers. The number of agricultural students is not large. My effort is to teach principles which may be elementary, but are yet fundamental. I do not attempt to turn out horticulturists or florists.

F. W. Rane, of New Hampshire. In my work I find it most desirable to get hold of one or two students who are interested in a special line of work, make them enthusiastic along this line, and by this means encourage others to come into the general horticultural fold—in other words, employ the topics which appeal most to them.

J. Craig, of New York (Cornell). I am of the opinion that in this work each teacher must arrange his course to fit the particular conditions which surround his college. There are in the main two classes of agricultural colleges in the country: First, the small institution which pays most attention to the undergraduate student, giving a considerable share of attention to the handicraft of horticulture and gardening; and second, the college whose chief function is to train the teacher—in other words, the post-graduate institution. In this institution less attention should be paid to laboratory work per se than to laboratory methods. The teacher should study his students and the work which they are expected to do in after life.

F. W. Card, of Rhode Island, read the following paper:

The Educational Status of Horticulture.

Horticultural education began when man first learned to grow garden products and told his neighbor how. The educational method thus introduced has been in vogue since, and has produced more good horticulturists than any other. It is still the school which trains the rank and file of the gardeners employed on private estates and the majority of practical horticulturists in all lines. We who are engaged in schools of another type are wont to place a low estimate on this kind of education, yet if we are looking for a particularly skillful man in any line this is the place to find him. Rule of thumb methods may largely prevail, but, decry it as we may, just this kind of training must ever form an important part of the education needed by professional horticulturists. The recognition of this general truth has led to the introduction and retention of manual training in many of our institutions. The mistake in this, if mistake there be, is not in overestimating the importance of manual training, but in assuming that the college is the best place to get it. Unquestionably the college is the best place to get some kinds of manual training, but it may not be the best place to acquire the details of handicraft in agriculture and horticulture. In so far as it is the best place, we are right in emphasizing it; in so far as it is not, let us leave practice to the school best fitted to teach it and principles to the one best fitted to teach them.

The next phase of horticultural education appeared when man began to take pride in the products which he grew and to exhibit them to his neighbor. This stimulated his neighbor to do as well or stimulated him to do better, in case his neighbor had a better product than he. The method has lost none of its effectiveness, and is a growing factor in education to-day, as shown by the frequency and extent of national and international exhibitions. The results, like many other educational results, are not easily measured. Yet no one can study an up-to-date horticultural exhibition and doubt that the results exist. It is a method often abused, often degraded, yet capable of accomplishing much, because facts presented to the eye appeal more strongly than those presented in other ways.

Closely affiliated with this phase of education is that accomplished by the horticultural societies. When man has done something creditable, he not only likes to show the product of his skill, but to tell his neighbor about it. If his neighbor has done something creditable, man wants to ask him how it was done. The horticultural society affords an opportunity to relate experiences and to ask questions. It gives the specialist a chance to tell his methods and others a chance to learn them. It brings together men who are interested in the same things, a prime factor in making education effective. Horticultural societies have had a vast influence in developing the horticulture and the horticulturists of our country. Their work does not stop with the mere interchange of experiences, for they are the chief factors behind most exhibitions, and the information brought to the surface at their meetings is scattered far and wide in printed reports. The education of the society is fragmentary and unsystematic, but it is intensely practical. It gets at the information wanted if it is to be had. This much education does not do.

Man may gain a larger audience by recording his experience in a book, although people are less likely to read a book than to attend an exhibition or public meeting. Practical men often look askance at this kind of teaching, because they think that the man who knows their business does not know how to write a book, and that the man who has been trained to write can not have experience in their own work. This is often true. Then, again, a book may soon be out of date, while the exhibition or public meeting is nearly always up to date. In spite of their limitations, books are an essential feature of horticultural education, and are likely to become a more and more important one. Some underlying principles and truths do not change. Books may well deal with these things, and such books live.

Up to the present time the agricultural journal has been the most important single factor in agricultural education, because it reaches more people and deals with a broader range of problems. Its education is unsystematic, but for that very reason there is something in it for everyone. Unfortunately, its success depends upon popular support, and the public is not always ready to support the best. Its usefulness, like that of all other means of education, is dependent upon the willingness of those whom it would teach to receive instruction, but it reaches out to the farm homes and helps in the daily tasks instead of calling the student away from them. Its influence does not cease at the end of school age, but goes with the pupil into his life work and keeps abreast of changes. It has felt the modern tendency to specialization, which, as in other fields, has brought gain in some ways and loss in others. Probably the ideal journal for the farm home does not exist and doubtless never will exist, for an ideal once attained ceases to be an ideal. Yet, upon the whole, it may be as nearly attained in this as in other lines of educational effort. Who can measure the educational influence of any one of the leading horticultural journals of the present day? May their work and influence increase and develop many fold!

The agricultural colleges were founded expressly for the upbuilding of the industrial classes. That work they are trying to do. Are they succeeding? Unquestionably the agricultural college is the factor which can do most for a boy if it can get him. The first problem is to get him. The harder one is to interest him in agriculture and horticulture. It is because the college gets so few students in these lines that it has been surpassed in importance by other means of education. It is doing more to lift farmers' sons and daughters away from the farm than to improve their condition as farmers. This is good work, but it is not the work which was intended should be done. Other institutions can do that as well or better. Are the colleges, then, untrue to their trust? No; they are struggling against a tide which they can not stem. Small wonder that they sometimes drift! Farmers' sons and daughters come to them for the express purpose of getting away from the farm. It is yet to be seen whether best results can come from attempting to stay this tide away from the farm toward the city or to catch the newer one setting in from the city toward the farm. Whichever the source of the material, the education should mean more than a knowledge of how to earn the dollar. It should, first of all and above all, develop the man and the woman.

One of the most potent factors in the whole realm of agricultural education is set at work when such a young man or young woman leaves the college halls. The influence and example of one such may uplift an entire community.

Latterly a new and vital force has appeared in the realm of college activity. The college has come to realize the partial failure of its own methods, and has begun to adopt and adapt some of the other methods mentioned. It has begun to reach out a hand to help those on the farms. It has started farmers' reading circles, correspondence courses, and demonstration tests. This is education of a much lower grade than the college would like to do, but it is education which is practical, which gets directly at the points where help is needed, and which does not take the student

away from his work. In the general problem of uplifting American agriculture this kind of education may in the aggregate, by reason of the greater numbers which it touches, outweigh the higher education which can be given to the few. We must never forget that the higher feeds the lower, but we should also remember that the lower stimulates the higher.

The experiment stations, headed by the United States Department of Agriculture, are coming to be, as they were designed to be, the fountain source from which new knowledge is obtained. A wide field of agricultural knowledge was already open when experiment stations were first founded, but their work is constantly adding to this knowledge and giving new impetus to explore hitherto untried fields. Their work is doubly important because, by adopting the methods of the agricultural journal, they reach out to the farm home and to large numbers of people. They are not hampered by the necessity of public patronage for financial support, though they do meet the opposite difficulty, based upon the fact that people often care little for what costs little. Upon their success in reaching readers their usefulness largely depends. Their range is narrower than that of the agricultural journal because confined to results of investigations only. Yet, upon the whole, the influence of the experiment station is one of the most important factors in agricultural education at the present time.

In the process of educational evolution horticulture has not yet been properly adjusted. Not only does it offer one of the most congenial professions whereby men may gain a livelihood, but it affords training of advantage to those in all walks of life. To those whose brains grow weary in other fields of effort it affords recreation and rest. To the student who deals with its definite problems it teaches keenness of observation, a quality essential to success in all callings. To the student of its biological problems it offers scientific and philosophical training of no mean order. One who has observed closely the influence of heredity and environment upon plants can meet the arguments of Weismannism or Lamarckism understandingly and bring to bear upon them observations of his own. The student of forestry, so closely related to horticulture, is led by a study of the influence of forests upon climate and water-flow to sociological considerations of the relation of man to man. To the student of ornamental horticulture or landscape gardening it gives training in the appreciation of the highest type of art. To the plant breeder it gives power, for it enables him to select and combine plant characteristics and mold them to his will. To all it affords breadth of mental training and spiritual upbuilding.

Since horticulture possesses such educational value, should it be extended to other types of schools and colleges? Why should it not appear in the curricula of colleges not agricultural? To urge its adoption there now may be useless, but in the tide of progress that time will surely come. Shall we then attempt to push it down into the secondary schools? That school work is already overcrowded, so much so that prominent journals are calling a halt. The number of subjects is already too large, and in the effort to crowd the maximum amount of each into the pupil's brain his strength and ability are already overtaxed. The number of subjects should be reduced, not increased; yet each is important. Which shall be dropped to relieve the pressure; what further one to make room for horticulture? A better opportunity exists at the bottom. The grammar schools and the ungraded schools are ready. They are eager for nature study, and glad to accept the help we bring. Horticulture may well form a part of nature study. Here are minds active and alert, eager to learn and few prejudices to be overcome. The amount taught may be small, but that matters little. If the interest can be aroused and maintained, the object sought will be accomplished. Picture and print will carry all we need to teach. Bright eyes and busy minds will do the rest. What more should we ask? Here may be instilled a love for the garden and farm which all the later years will not efface. No more hopeful door for horticultural teaching stands open to-day. Shall we not enter?

It is evident, then, that the professor of horticulture does not hold the only nor the most important position in horticultural teaching. Horticultural instruction is conveyed by word of mouth and by practical experience in the school of the gardener and the commercial grower, by comparing experiences in horticultural meetings, by object lessons in the school of the exhibitor, by reporting the results of experience and knowledge in books, by scattering far and wide such results and up-to-date information in the press, and by the experimenter who seeks new truths and adopts the method of the journalist to make them known, as well as by the professor in the class room. If the latter be wise he will consider well the methods of the others. Some of these methods may be better than his. He may be able to adapt them in part to his own use. He will remember that there are many sons and daughters, many fathers and mothers, at the farm firesides who need his help, but who will never come to his class room. He will consider well how he can best fulfill his duty to them.

He will, above all, strive to comprehend the possibilities of his subject, to grasp it in its fullness, and to convey from that fullness not only that which will aid in gaining a livelihood, but that which will assist in the development of the highest type of educated manhood and womanhood.

The following is a summary of remarks by J. Craig, of New York:

University Extension in Agriculture at Cornell University.

The university-extension movement is not new in arts and letters. It is, however, decidedly new in agriculture. I do not at this time intend to give you anything like a complete review of the rise and development of this new feature in agricultural education, but will rather sketch briefly the history of its growth in New York State.

THE BEGINNING.

Agricultural extension in New York stands unique among educational movements in that it had its beginning with the farmer. The farmer furnished the *raison d'être*. In 1893 there was a request made to the college of agriculture, by a group of farmers in Chatauqua County, for certain investigations and experiments in that region. This is the acknowledged grape-growing section of New York, and, as is common in all regions where agricultural specialties are practiced, particular difficulties had arisen. The farmers sensibly applied to the experiment station for help. At that time there was no money available at the station to cover the expenses of work of this kind. The farmers were so informed. But they were resourceful men and not easily discouraged. They laid their case before the committee on agriculture of the State legislature and obtained a special grant for the purpose of carrying on work of this character in their own and adjoining counties. This was known as the Nixon bill. The money was placed in the hands of the college of agriculture, and was administered at first by the department of horticulture. The movement grew and flourished. The money was used for educational horticultural schools as well as for investigational purposes, and experiments were conducted in regions where there seemed to be special reasons for instituting them. This was in 1895. In 1896 the work was broadened into a great general movement having for its object the improvement of the farmers' position. The grant has been increased by the State until it has reached the sum of $35,000 per annum.

UNIVERSITY EXTENSION.

The college of agriculture has now established a department of university extension. The work of this department divides itself into two sections: (1) The farmer and his fields; (2) the rising generation. (*a*) The main feature of the first division is the farmer's reading course. This is the central theme around which various lines of work are grouped. The farmer can not come to college. Neither has he had time to become a scientific observer. Reading lessons upon fundamental subjects are distributed at intervals during the farmer's reading season—the winter. These lessons deal in a concise and clear manner with the main principles underlying a successful agriculture, and are accompanied by quizzes, which are to be returned. Their object is to assist farmers in thinking out scientific problems by themselves. In the lessons a problem is set and a solution suggested. (*b*) Experimental work. It is our aim to make the lessons of such a character that the reading and studying of them will suggest possible experiments on the farmer's fields. It is then our pleasure to assist the farmer in planning and carrying out these experiments. In this way the farmer becomes at once an important cooperator and an assistant to the college of agriculture. We have great faith in the ultimate effect and result of this farmers' reading-course movement, whose central idea is to educate the farmer rather than to give him mere information. We are glad to say that the movement is gratifyingly popular among the farmers of the State. Beginning with a membership of some 1,500 in 1897, it has grown till it now reaches, in round numbers, 20,000. Another cheering feature of the work rests in the fact that among our readers we have a large following of the younger men of the country. The direct result of this work is to improve methods of farming and to awaken a desire for more wisdom, which may culminate in some instances in a decision to complete the reading course by taking the winter course in agriculture offered by Cornell University, which is now a part of the extension movement. This we look upon as the ideal method of finishing the correspondence course.

NATURE-STUDY MOVEMENT.

The nature-study movement is so well understood and has become so phenomenally popular in recent years that very little need be said on that subject at this

time. It is a pleasure, however, for me to take this opportunity to bear testimony to the zeal, enthusiam, and perseverance of the members of the staff of agriculture at Cornell, led by Professor Bailey, who have been leaders in the work and who have given unselfishly and unstintingly of their time and energy for the furtherance of the work.

This movement had its germ in the thought that the place to remedy a fundamental difficulty of agriculture was in the rural and city schools with the younger children. To ascertain the attitude of children and the teachers toward the movement, at the beginning, a number of schools were visited by instructors of the university. These visits and talks disclosed a keen desire on the part of the majority of the children and a number of the teachers for a closer touch with things natural. Especially was this desire shown by the children. These early visits to schools also disclosed the fact that one of the first things to be done was to educate the teacher, and here was the beginning of the work of the university in nature study. This has been accomplished in part by the issuing of nature-study leaflets containing suggestive outlines of suitable topics for nature-study illustration. These leaflets were at first issued irregularly. As the work increased and became systematized it was decided to issue them at regular intervals throughout the year. They are now published quarterly and are issued in editions of 30,000.

Perhaps one of the most unique, and possibly most important, divisions of the work is the Junior Naturalist's Correspondence School. In this school there are marshaled a great army of little ones. They are grouped into circles called "Junior Naturalist Clubs," and are scattered not only throughout this State, but throughout the United States. They have even crossed the waters, and are found in Europe and Asia. Each club is organized by the teacher. When properly organized each club receives a charter from the bureau of nature study. The Junior Naturalist is a small publication devoted to child nature study topics and is issued monthly. Each member of every club receives a copy. There are no money dues connected with these clubs, but still there are dues. These consist of personal comments by the children on each number of the Naturalist, or upon any other topic which may have caught their attention during the month. The clubs are organized for one year and are disbanded at the end of the school year. To illustrate the popularity of the movement, I need only say that since September 1, 1900, when the work of the new school year was again taken up, 750 clubs have been organized, containing a membership of over 30,000 children. There is no question in my mind that this Junior Naturalist movement will be rich in results bearing upon the uplifting and advancing of the farmers' position and interest throughout the country.

Such, in brief, are the bare outlines of a movement whose value and worth are not to be measured by the rural achievements of this decade or the next quarter of a century. I believe that the results are far-reaching to an extent that we do not at present appreciate or realize.

W. H. Jordan, of New York. I am glad to be in a position to bear testimony to the valuable work being done by Cornell University in interesting the farmer and the farmer's boy in rural problems. The work is significant; the results are bound to be far-reaching and important. Experiment station bulletins are often too technical and need to be translated for the benefit of the farmer.

A nominating committee was appointed by the chairman, as follows: F. W. Rane, of New Hampshire; W. E. Britton, of Connecticut, and B. D. Halsted, of New Jersey.

G. E. Stone, of Massachusetts, read the following paper:

The Function of the Station Botanist.

The function of the Station botanist constitutes a subject which will allow considerable elaboration, but I wish to state at the outset that it is not my intention to carry it to its limits, and the paper which I have prepared is brief. On account of the diversified agricultural interests existing in the United States, it so happens that the particular function or specific line of work of the experiment station botanist is not always the same for each locality. The station botanist of one State may have presented to him as the most urgent line of work the study of fungus diseases of fruit trees, market-garden crops, etc., and their treatment, while in another State the diseases of corn, oats, wheat, etc., would suggest to him the necessity of paying most of his attention to a consideration of the diseases of these crops. But while the diversified agricultural interests of the United States may call for a specific line of work among botanists, or special problems to be solved in this or that section, there should be no mistaken idea as to what the botanist's function or relationship to the station and farmer should be. We believe we are correct in stating that the function

of the experiment station botanist is primarily to investigate along lines that coincide with agricultural progress—using the term "agricultural" in its broader sense. This function manifests itself in the study of disastrous plant diseases and remedies concerning the same, weed suppression, plant breeding, seed testing, etc., together with supplying information and solving the various physiological and pathological problems which have an immediate and subsequent bearing on agricultural practices. We may term such botany agricultural or economic botany, as we choose; nevertheless a considerable portion of such work may be classed as vegetable pathology and physiology. Some of these lines of work may sometimes fall to the horticulturists, as circumstances determine; inasmuch as the line of work between station botanist and horticulturist is not always sharply drawn. It is the function of the station botanist to publish the results of his investigations in such a manner that the utilitarian features or more practical part of such investigations can be understood by the particular class of agriculturists whom they are most likely to concern.

The practice of publishing bulletins of a popular nature endeavoring to give instruction of a general kind to agriculturists has also constituted the function of the station botanist to a greater or less extent, as it has other station workers. Indeed, some station officials have even gone so far as to maintain that it is the primary function of the experiment stations to devote themselves to the promulgation of popular digest, or tracts, rather than the results of original research. There are some States, as is well known, that have special appropriations to carry on purely elementary education in agriculture, the funds being large enough to maintain a separate series of publications relating to this work. There is no doubt in our estimation that such work is valuable in its proper place, inasmuch as such subjects as agriculture and horticulture need to be brought before the people more than any others. There has been, and there is to-day, more or less contempt for these subjects existing among the people, and it seldom occurs, according to my experience, that a clergyman or a classical college graduate will ever advise a student to attend an agricultural institution. There are also sociological reasons why agriculture and horticulture should be brought before the people; and so long as these conditions exist we believe it is a legitimate work for those who follow agricultural callings to interest people in this direction. We do not believe, however, that it is legitimate for stations to publish in their regular bulletins work of this nature, as they should be reserved for the publication of matter based upon research. The function of experiment stations is ably set forth by Dr. Armsby, of the Pennsylvania Station. In his presidential address before the Association of American Agricultural Colleges and Experiment Stations he presented an entirely different view of the function of the experiment stations than that embodied in the popular digest idea. Dr. Armsby states: "The function of the experiment station is not the impossible task of giving him (the farmer) recipes suited to every conceivable emergency. Its business is to enlarge his knowledge of the natural forces which drive his farm, as the steam drives the engine, and to teach him to control them instead of being controlled by them. It is not a device to save the farmer the trouble of thinking. On the contrary, its constant and insistent demand is that he think more. It can help him permanently and effectively only to the extent to which he can by such thinking digest and assimilate its help."

Dr. Armsby does not maintain that the experiment station is not an educational institution, on the other hand he maintains that it should be one of the highest type; one whose instruction should be based on research and not a compilation or rehash of elementary text-book material. In other words the essential idea of the station is research, the discovery and promulgation of truth. We prefer this conception of the experiment station rather than that conception based upon the idea of popular digested material for the agriculturist's consumption. It is needless to state, however, that what applies to the experiment stations as a whole applies with equal force to its component parts. This conception of experiment stations does not necessarily imply the employment of technical language in a bulletin where research work is set forth; on the other hand it is possible as it is evident from the fact that it is very often done to elaborate the result of research work to the extent that it is simple and comprehensible to any intelligent agriculturist. We recall bulletins of a pathological nature which, besides giving excellent accounts of the life history of fungi causing diseases and the valuable results obtained from spraying, give in addition simple and valuable accounts of the structure and function of the organs on which the fungus preyed. This latter feature is by no means essential to the ordinary botanist and horticulturist, but it succeeds in making the account of the disease more intelligible and enables the agriculturist to form a more rational conception of the pathological cause associated with the disease.

Bulletin No. 80, issued by the Office of Experiment Stations, gives a complete list of all the station publications up to the year 1899, and by consulting this list an idea

can be obtained of how far the scope of the bulletins relating to botany represent research of an agricultural nature. A casual examination of these titles by States will show that in those States where experiment stations have been established for some time and which possess the best equipment, a wide scope of work requiring many departments has been undertaken and the idea of research work presented in an untechnical form has been to a considerable extent in vogue. On the other hand in those States where stations have not been so long established and where the equipment is not so good, recourse has often been had to the publication of compiled material, and in some cases material has been published which it must be confessed has little bearing on agriculture. The publishing in bulletins by station botanists of local floras, of systematic researches on phenogamous plants have a very remote connection, to say the least, with agriculture. It is not our intention, however, to disparage this class of work even when done by station botanists as a side issue; nevertheless, we maintain that material of this nature should not occupy space in station bulletins, but should be presented elsewhere for publication. The publication of weed and grass floras, showing their distribution, possesses a value to farmers, especially if they are accompanied with suitable illustrations, and the weed publication possesses more practical value when experiments relating to their suppression are given. As a general thing the scope of the station botanist's work must be confined to vegetable pathology and physiology in order to assume an economic form. A knowledge of the latter is not only necessary to understand the problems connected with pathology (as the two are intimately connected) but there are in addition problems of a physiological nature which bear directly upon agriculture. Much of our early pathological study in this country was done without knowing much about the normal conditions of plants and the laws that govern them. It too often happens that the pathological condition of the plant is directly due to abnormal environment, and the proper remedy for this class of disorder does not consist in spraying, but in establishing a normal condition for the plant. This is especially true in those instances where plants are grown under cover, and in pot experiments conducted largely by chemists we frequently find too little attention given to the normal requirements of the plant. To place a series of plants in an abnormal condition with the expectation of drawing reliable deductions from their behavior, with respect to special treatment, is absurd. Not only in this respect have deductions been drawn which possess no value, but individual variations and variations due to environment have too often been ignored. These are all physiological factors which must be taken into consideration in various kinds of experiments. The standard of bulletin literature as a whole is far higher than ten years ago, and I think it can be safely stated that few station divisions are superior to that of the botanical. We know of but one branch of botany pursued in the United States of which it can be said that it has no equal in Europe, and that branch is vegetable pathology.

It is worth while knowing that the development of this subject has been largely attained through Government employees and Government funds, the experiment stations being in no small degree influential. For some years it has not been necessary for one to cross the water in order to obtain a knowledge of economic fungi, and there are a number of places existing at the present time in the United States where one can receive better instruction in this branch than is possible elsewhere. We believe that it is no exaggeration when we state that there is more practical work done in this country in pathology and treatment of diseases in one year than is done in the whole of Europe in three years. This is in no small measure due to the inherent utilitarian genius of American investigators, a characteristic which is regarded abroad as constituting one of our strongest features, and in our estimation is one worthy of the highest consideration.

The central idea which I have endeavored to bring out in this paper is that the function of the station botanists is primarily research, the nature of which must bear an intimate relation to agriculture.

F. W. Card asked what shall be done by the horticulturist in States where there is no botanist or entomologist? Shall the officer whose work lies nearest these departments republish and retail information first published elsewhere, or must his work be original? In other words, is the so-called popular bulletin justified?

B. D. Halsted stated that information of an educational nature should be published. In New Jersey they have adopted the plan of issuing short articles on special topics—sort of emergency bulletins. These are sent to the press and to special correspondents under frank, and are found to be very valuable in that State.

T. A. Williams thought the publication of new species in station bulletins is out of order, but that lists of varieties and species of more or less well-known plants,

cultivated or wild, which in themselves have educational value, should form legitimate matter for station publication.

F. W. Rane believed that in most cases a simple straightforward educational effort, whatever line it may take, is rewarded by the best results.

W. T. Swingle believed that the personal influence of the botanist or horticulturist is a very important factor in popularizing the work of the department. This personal influence may often take the form of an advisory nature.

F. W. Rane, of New Hampshire, read the following paper:

Progress of Variety Testing in Experiment-Station Work.

Since our experiment stations were first organized variety testing has received more or less attention. The earlier work of some of the stations was largely of this nature. The testing of varieties has continued to the present as work worthy of recognition; otherwise it would not be carried on, or at least receive the attention given it at present.

At the Denver meeting of this Association, July 16–18, 1895, the writer read a paper on "Some undefined duties and methods of station horticulturists." The main stress of that paper was to emphasize our exact position as regards variety testing as a whole, and as well the manner and extent to which it was being conducted or handled by the various States or institutions at that time. It is undesirable to review the work done in the preparation of that paper at this time. The interest then aroused, together with later experience and observation, is my excuse for this presentation.

By reviewing the earlier reports one is struck with the great amount of work and attention given to varieties. The publications are largely made up of descriptions of varieties and tabulated variety comparisons. Although one of the earliest attempts as experimental work, it nevertheless seems to have made little definite progress generally, and in fact seems to be looked upon by many as of little importance. The writer, having had the work of organizing the horticultural departments in two experiment stations of different States, and, too, somewhat later than most similar work in other stations, and at a time when variety testing was rather unpopular, was given an opportunity to look critically into its value.

At present, variety testing seems to lack a definiteness of purpose. While it is tolerated, many seem to regard it as so much packing material to fill up the waste places. The exact ideas of some of our horticulturists are as follows:

(1) "The work must be constantly maintained, but is really the trifling incident of hard horticultural work."

(2) "I do as little as possible and use only those varieties I think worthy."

(3) "We make no attempt to test novelties. We get in all the varieties we can of any subject which we take up for serious study, but we never make any miscellaneous tests of anything simply because they are new."

(4) "We endeavor to get all of the latest and best things in one way or another."

(5) "I select varieties always with this thought when reading the description: Suppose it is true, of what account would it be to my State?"

(6) "I have about come to the conclusion that it is best to look with suspicion upon all new introductions unless they are brought to the notice of the public through some of the regular channels, and accompanied by statements of disinterested horticulturists who are recognized as authorities."

(7) "I am devoting less and less time to variety testing each year. Let us reverse the engine and originate new varieties for others to test instead of exerting our energies in hunting up things that nonprofessional horticulturists are developing for us."

(8) "I think that if the greatest part of the work that has been done in the way of variety testing had been left undone we would have been just as well off, and a vast amount of work saved for more important things."

These quotations are sufficient, it seems to me, to indicate in a general way our exact position at present. While most stations are doing more or less with varieties, the general feeling seems to prevail among station workers that after all it is not worth the time and expense necessary. Certain stations, however, have never discarded the yearly variety test. Among these I mention as examples Ohio and Michigan. These stations have made variety testing an important part of their work, and I am inclined to believe that this feature of their work has brought them in close touch with the farmers and gardeners of their States, and has given assistance where it has been needed more than any other one thing.

So-called "hard horticultural work" and "more important things" have been

accomplished by them and other stations also, but, after all, the thing that must appeal to everyone is the ultimate results accomplished. Variety testing as often carried on, with little definite object in view and perhaps but for a season or two, doubtless does become irksome and productive of only spasmodic value. Long-continued, careful, and systematic variety testing can not help but be of increasing value. When of this sort, it becomes nothing other eventually than the evolution of economic horticultural plant life. It necessitates considerable work, and hence expense; but if the experiment stations can not afford this expenditure, surely it must be burdensome for the individual. If the work is better systematized, however, it doubtless could be accomplished at far less expense than at present. It may be necessary when testing for the first time to select the older varieties, together with the recent introductions, using the former as the standards of comparison. This necessitates a good deal of work at first, but after a few years the test will resolve itself to the simple determination of the value of later introductions. The really new introductions each year are very few. In order to get data on this point bearing upon vegetables we examined 12 catalogues[1] for the year 1900 and found the following number of new introductions: Four beans, 3 beets, 1 carrot, 3 cucumbers, 2 lettuce, 2 muskmelons, 1 onion, 2 peas, and 2 potatoes, making a total of 24, or an average of 2 new introductions each. This is a fair list, and, if anything, a larger list than usual. Where work is carried on with flowers perhaps the list would contain a larger number of new varieties, but with fruits, trees, and shrubs it is questionable if the number would be as large as that of vegetables. Few stations do much with floricultural varieties in the way of tests, as the trade itself is extremely progressive.

From observation, it is believed that those States that attempt and carry on the work of variety testing systematically are the ones that elevate the importance of general agriculture and horticulture in their respective States and gain recognition elsewhere. This is not to say that stations that do not do this work are not accomplishing other important work; but I believe that variety testing needs and demands better recognition. It is an advantage, also, that the station worker in charge of this work be retained, as such frequent changes upset and detract from its value. If a station has a complete record from year to year of the various varieties and their behavior, even though many are discarded, the data will be valuable for answering inquiries. Such testing thus becomes an evolutionary study of varieties. Stations will do well, it is believed, to file the better annual catalogues of the trade, as they always contain full descriptions of new introductions together with the year and their pedigree. One horticulturist tells me that he binds up certain trade catalogues and believes the expenditure well spent.

It seems needless to give examples to demonstrate the value of the variety test, as each at this meeting must have had definite experience. The value of the tests made by the late editor of the Rural New Yorker, Mr. Carman, and the interest shown generally in them, even by horticulturists themselves, offer a good illustration of what can be made valuable. From personal experience, both as student and as experimenter, I feel that the work of variety testing, besides being of value to the class of people, or the constituency for which the stations are supposed to exist, has been the means of initiation or an opening wedge for bringing the station and its work to the people or them to it. The people in our State to-day who are getting the most value from our assistance are those who have come in touch with the station in the first place through correspondence over variety test work. Not all cooperated in the work, but those who did were the channels to others. When men take a personal interest in the work they take pleasure in advancing it, and valuable information or assistance is easily obtained, I find, in this way.

One reason that variety testing has become so unpopular, it seems to me, is on account of the innumerable bulletins that we receive that are of such little general value. Because they do not interest some, they are thrown aside with disgust. These same bulletins may be of great value in the State and hands of those for whom they were written. They certainly, however, can not be of less value than the ever appearing commercial fertilizer analyses bulletins, so common to all.

The variety test is of great value to the horticulturist himself. He can not keep in close touch with his constituency or associates without familiarizing himself with varieties any more than a literary man can feel at ease when discussing the latest novels which he has simply seen or heard about but not read. It is like institutions trying to teach agriculture without any agricultural inspiration or environment. If

[1] W. Atlee Burpee, H. W. Buckbee, H. A. Dreer, D. M. Ferry & Co., J. J. H. Gregory & Sons, Peter Henderson & Co., Johnson & Stokes, D. Landreth & Sons, Livingston's Seed Company, W. H. Maule, John A. Salzer Seed Company, and Vaughan's Seed Store.

the horticulturist is familiar with the varieties himself, his work, whether it is teaching, institute work, or writing bulletins, will result in proportionate good. Exceptions may and do arise; for example, one person can absorb this work from practical men when visiting their estates, and if sufficient pains and study be given them, this may answer and in fact is commendable.

It is believed that where one person makes a success in this way the great majority will fail. In order to get the best results closer contact is desirable. I have found it advantageous at times to have a reliable and experienced man in another section conduct a comparative test of one kind of vegetables for me, but unless I follow the work closely it does not amount to much on account of lack of attention. I believe we can not inform ourselves too much nor afford to miss the great opportunities of getting the ideas of others, but there is nothing that gives better experience than personal supervision and contact. This, it seems to me, will bring horticulturists into closer touch with the practitioner and form a base from which "the hard horticultural work" or "work of more important things" can and will justly emanate and be productive of much good. Even with horticultural students my experience has been that if you can once get them interested in working up a thorough knowledge of the varieties of certain fruits, vegetables, or flowers, the interest thus created incites a continuation of the work with other things, which he takes up and comprehends of his own interest. If you have not tried this, I recommend it as one of the best kinds of laboratory practice.

There are many points not as yet agreed upon that might be done toward simplifying the work, some of which are hinted at in my last paper. Some of these are:

(1) Where should we get specimens for testing?

(2) Should stations not have a definite understanding with seedsmen or nurserymen?

(3) Is it our place to recognize unknown introducers?

(4) How many plants should be considered a fair test?

(5) When should we eliminate the test?

(6) Should plants under test be sprayed for diseases and pests?

(7) What is the horticulturist's place in disseminating seeds and plants?

(8) Is it advisable to report tests to individuals or firms in any way other than through published bulletins?

These are not all, but, with others when understood more fully, will assist in systematizing the work.

In view of the facts named and with a deep desire to see all horticultural work prosper, I am sincere in my appeal to horticulturists and institutions interested to keep up the work of variety testing, giving it its due recognition.

F. W. Card stated his belief that the importance of this subject is relative; in fact, largely a question of condition. Where varieties are well known, and where there is good horticultural organization, there seems to be little reason for expending much energy or time in the work of testing varieties.

W. M. Hays, of Minnesota. If we do not test varieties we would not know which to recommend or which to choose should we undertake the broader work of plant breeding. I believe variety testing is legitimate work for the experiment station and should have a definite place in the yearly programme.

J. Craig stated that he had found variety test work one of the best means of coming into close contact and in many cases of obtaining the sympathy and confidence of the farmer and gardener. In the station this work takes the place and does the work of the popular bulletin and should not be overlooked.

The following is an abstract (by the author) of a paper read by B. D. Halsted, of New Jersey:

What Our Experiment Stations Have Done in Originating Varieties of Plants by Crossing, Selecting, etc.

In response to a letter of inquiry sent to all the station directors the following facts were obtained:

Alabama is improving cotton by crossing.

Illinois has been breeding corn and it has been found that crossed corn is an improvement.

Iowa is breeding orchard and garden fruits and has produced hybrid roses of value.

Kansas has done some work with corn breeding.

Louisiana is improving sugar cane by selecting cuttings.
Maine is producing hybrids among tomatoes.
Massachusetts has much work in hand along lines of plant improvement.
Michigan is prominent in trials of varieties and selection of the best sorts of fruits and vegetables.
Minnesota is leading in the breeding of wheat.
Missouri is active in plant breeding of fruits and vegetables.
Nebraska has several lines of plant improvement under way.
New Jersey is starting in crossing and hybridizing.
New York (Geneva) has a large showing for plant breeding.
New York (Cornell) is a leader in station work in the improvement of plants.
North Carolina is active in selection and crossing of plants.
Oregon has a good showing in new ornamental plants.
Rhode Island is starting in the work of plant breeding.
South Carolina is hybridizing cottons.
South Dakota is devoting much time to plant breeding.
Tennessee—something is being done in variety work.
Vermont is active in the fundamentals of plant breeding.
Washington is crossing winter wheats.
Wisconsin has some work done in crossing fruits.

In the above digest of the results of our experiment stations in plant breeding it has not been the intention to include all the work done along the above line in the United States. Much has been accomplished by persons who were not associated with experiment stations and agricultural colleges, and in fact did their work even before these institutions came into existence. In this connection one first recalls the development of our American grapes and the infusion into them of the European blood and calls to mind the names of Bull, Rogers, Haskell, Rocketts, and Moore of the East, while Rommel, Jaeger, and Munson have labored faithfully in the Southwest. These and others have already made America famous for its long list of varieties of superior crossbred grapes.

Among pears we have blended the blood of the common with the Chinese species and obtained varieties that have made pear growing possible, if not very profitable, over a wide region where it was precarious before. The names of Keiffer and Leconte will be associated with these excellent results in hybridization.

The fact that the ordinary varieties of Eastern apples were not hardy in the great cold Northwest early led to importation from Russia, and the crossing of the common species with the Siberian Crab, the good results of which are still in store for the people of the twentieth century.

For similar reasons the native plums in the West and South have been placed under culture and bred with the European types. Along with this is the advent of the Japanese plums and the formation of a group of hybrids that places the name of Luther Burbank among the world's great horticultural benefactors.

Less distinct from the experiment stations than many of the plant-breeding enterprises included in the above general remarks is the work upon the citrus fruits by Messrs. Webber and Swingle, of the United States Department of Agriculture.

The "Florida freeze," from which catastrophe the orange growers now date all passing events, aroused the Government to the point of seeking for a more hardy orange, and the hybridizers are well on their way to produce it.

Space does not permit of more than a passing allusion to the hundreds of florists who are constantly keeping American floriculture in the van, particularly as to new crosses of carnations, chrysanthemums, and roses.

For the last few remarks I am indebted in part to the excellent paper, "Hybridization in the United States," by Professor Bailey in the recently issued Report of the Hybrid Conference, held at Cheswick and London in July of last year, at which Professors Webber, Swingle, and Hayes took part, and besides Professor Bailey, Dr. Macfarlane, and Mr. Thomas Mehan sent papers. In this world's conference upon a world-wide subject the United States took its full share of honors.

It now remains for the experiment stations to follow up the work so well begun, and remember that he who improves the plants of a country improves its products and its people.

The committee on nominations reported the following names for officers:

For chairman.—L. R. Jones, of Vermont.

For secretary.—W. J. Green, of Ohio.

These nominations were confirmed.

The following paper was read by J. G. Smith, of the United States Department of Agriculture:

Seed and Plant Introduction.

The work of seed and plant introduction was first undertaken on a systematic scale by the United States Department of Agriculture in 1897. Previous to that time there had been many sporadic efforts, some successful, others unsuccessful, but all without definite direction or trend. The work owes its inception and its establishment on a firm basis to our present Secretary of Agriculture, Hon. James Wilson.

The immediate credit for the establishment of the work belongs to Prof. B. E. Fernow, formerly Chief of the Division of Forestry. Dr. Fernow during the last year of his connection with the Department was much interested in the problems connected with reforesting the arid regions of the West, and it was with the view of procuring seeds of arid land forest trees in West Australia that a commission was given to Mr. D. G. Fairchild as special agent in charge of seed and plant introduction. Mr. Fairchild was at that time on an exploring expedition, accompanied by his friend, Hon. Barbour Lathrop, of Chicago. The commission did not reach Mr. Fairchild until he had left Australia, so he did not secure the seeds. But at once, upon his return to the United States, he entered the Forestry Division to continue the work on a broader and more general scale.

Many successful importations of seeds and plants which have proved of direct commercial value to the various agricultural interests of the country were made between the period of establishing the United States Department of Agriculture and the appointment of Mr. Fairchild in 1897. Among these, perhaps, the most important were the introduction of the navel orange through Mr. William Saunders and the introduction of sorghum and Kafir corn through the Chemist of the Department. There were many others of great importance, but these were perhaps the most striking in their immediate results to American agriculture. Mr. Fairchild remained in charge of the seed and plant introduction until December, 1898, at which time he commenced an exploring expedition under the patronage of Hon. Barbour Lathrop, of Chicago. The exploration lasted twenty-one months. During this period Messrs. Lathrop and Fairchild explored the West Indies, Venezuela, Colombia, Peru, Chile, Argentina, southern Brazil, England, Norway, Sweden, Finland, Austria-Hungary, Italy, Egypt, Ceylon, and the Straits Settlements of Siam, Java, Sumatra, Borneo, Molucca, Celebes, New Guinea, Shanghai, and the Philippines. Besides procuring over 450 different items of seeds and plants, a vast store of information was acquired, which will be of the greatest assistance to the future explorers who will be sent out by the Department to these countries, but more especially to the farmers and fruit growers of this country. During Mr. Fairchild's absence, Mr. O. F. Cook, whose work along the lines of tropical agriculture is well known, was placed in charge, and under his direction a system of double card cataloguing was carried out and a list of the importations of the Department was made for publication in the form of inventories or catalogues.

The initial stage of the work has now been gotten safely over. The importations of the past three years have been extremely numerous and much material has been secured which could not be properly utilized, but enough has been learned from the mistakes of the past so that it is hoped now to carry on the work with the greatest economy of time and money, with the least official routine, and with greater results for the expenditure of a given sum of money. The establishment of new agricultural industries in the United States is of the greatest importance. There are too many areas where the farmers are engaged in growing one crop. The theme of the sermon preached by agricultural workers in the State experiment stations, in the agricultural colleges, and in the Department of Agriculture has for years been diversified farming. It would be better for the cotton planter, the corn grower, and the wheat producer in the corn, cotton, and wheat belts to grow less cotton, less corn, and less wheat, and grow more of some other crop. A farming community which produces only one crop is at the mercy of the great trade combinations which control the marketing and manufacturing of that raw product. The most prosperous agricultural communities in this country are those where the farmer has more than one string to his bow. The development of secondary industries is, I believe, one of the most profitable lines of work which can be undertaken by the experiment stations and the Department of Agriculture. When we remember that the annual agricultural imports into the United States amounts to upward of $300,000,000, a need of such diversification can not but be self-evident.

If one examines the Treasury report in regard to the imports of merchandise into the United States one can not help but be impressed by a number of agricultural products which might just as well be grown in the United States. In the year ending June 30, 1899, nearly 2,000,000 bushels of wheat were imported and $1,000,000 worth of breadstuffs, including over $600,000 worth of macaroni and other pastes,

$2,000,000 worth of wine lees, $1,000,000 worth of dyewoods and extracts, $4,000,000 worth of gums, $1,700,000 worth of indigo, $1,500,000 worth of licorice roots, $2,000,000 worth of opium, $1,250,000 of quinine, $5,000,000 worth of drugs and dyes, $5,500,000 of cocoa, $55,000,000 of coffee, $1,500,000 of cork, $5,000,000 of cotton, $1,300,000 of flax, $2,250,000 of jute, $500,000 of hemp, $9,250,000 of sisal hemp, $6,250,000 of manila hemp, nearly $13,000,000 worth of manufactured fibers; $18,500,000 for fruits and nuts, including bananas, currants, dates, figs, lemons, oranges, plums, prunes, raisins, almonds, cocoanuts, etc.; $50,000 for honey, $600,000 for hops, $32,000,000 for india rubber and gutta-percha, $3,000,000 for vegetable oils, $1,700,000 for essential oils, $4,000,000 for rice, $1,200,000 for seeds, $2,750,000 for spices, $140,000 for starch, $250,000 for straw and grass, $96,000,000 for sugar, $9,700,000 for tea, $12,000,000 for tobacco, over $2,000,000 for vegetables, and $7,250,000 for wines.

With this startling array of imports of plant products there need be no apology for the systematic work of seed and plant introduction. With such a host of lines in which to work and with the whole world to draw upon, the problem becomes one of, What is the best way to accomplish satisfactory results; what to undertake and how to do it? In the last four years' work of the section great things have already been accomplished—the importation, through Hansen, of the Turkestan alfalfa, a variety which stands more winter cold, more alkali, and grows with less water than the strains now cultivated in the United States, and which is worth $1,000,000 to the United States because of its extension of the area in which this extremely valuable forage plant may be grown; the importation, through Knapp, of the Kiushiu rice from Japan, which has been the direct cause of the investment of $20,000,000 of Northern capital in the rice lands of Louisiana and Texas, on account of which the value of the annual rice product has increased within two years over $1,000,000; through Fairchild, Janovitch cotton has been brought in; also seedless raisin grapes from Italy, Egypt, and Peru, brewing barleys from Sweden, and a host of other things, the value of which can be estimated by the hundreds of thousands of dollars; through Swingle's successful importation of the Smyrna-fig insect the fig industry has been placed on a commercial basis in California, and his work with the date palm will lead to the utilization of 100,000 acres of land in southern Arizona, where the soil was too alkaline and the climatic extremes too intense to permit the cultivation of any other crop; and the importation, through Carleton, of wheats and millets from Russia have added a large money value to the products of the cereal-growing States.

Other department work of less striking importance, but yet work which will count in the long run, is the investigation of the lilies in Bermuda, by Kaines; the recent importation of prunes for the southwest, through Lake; the establishment of the table-grape industry in Florida and South Carolina, through the efforts of Taylor.

The organic law establishing this work requires that it shall be done in cooperation with the State experiment stations. Sufficient has been done within the last four years to give us an idea as to the most economic method of procuring seeds and plants, and also we have had sufficient experience so that we are now able to care for the seeds and plants with the least expenditure of time and money. Far more seeds have been imported in the past than could be satisfactorily taken care of, and the first conclusion would be that it will be best in the future to concentrate along certain lines of work or toward the development of industries in certain definite regions.

There has been much complaint from experiment station men because of the plethora of good things, and there has been some disinclination among some of the experiment stations to undertake cooperative work along these lines.

From the departmental standpoint it is impossible to definitely predict when a man is sent abroad for exploring purposes what he will procure, although we can instruct him to confine his efforts along certain lines. Circumstances may arise while the explorer is in a foreign country which prevent the carrying out of the plans previously agreed upon, and we often can not tell what seeds and plants will be available for distribution until within a few weeks of their arrival in the United States. There is no doubt in my mind that in the past we have attempted to do too much. The seven published catalogues or inventories include 3,400 separate items and there are over 2,000 yet not published. An explorer who goes to a foreign country for the first time is prone to invest money in everything that he sees that seems to be new. The proper judgment in regard to the value of this or that importation only comes to a man who is accustomed to foreign travel and who at the same time keeps abreast of the times in the United States.

The most successful importations, as a rule, have been those which were secured by the trained agricultural explorers of the Department. It is believed that the best interests of this work will be met by the employment of at least a few permanent

explorers. Exploration work in foreign countries carried on by men not accustomed to travel is extremely expensive, both because of their ignorance of foreign methods of transacting business and also because it is a common tendency of men who visit foreign countries for the first time to purchase seeds and plants of a greater range and in greater number than can be efficiently utilized. The temptation to purchase not simply the best, but everything new in sight which the traveler meets, is almost irresistible. Nevertheless, good results can sometimes be obtained by sending abroad specialists who are acquainted with the needs of a certain region or who are interested in the cultivation of some particular crop, even though their connection with the work of plant introduction is not continued after they have secured the material for which they were sent abroad.

Now, with these ends to be attained the question is, What relationship can be entered into between the Department of Agriculture and the State experiment stations which will lead to the accomplishment of the best results? I believe thoroughly in cooperation. The present is an age of centralization of power and centralization of endeavor, not in the hands of one man, but in the hands of a great many men united as a board to direct and carry out lines of work. I believe that the best results can be obtained in seed and plant introduction by centering along fewer lines; that is, I believe that by attempting less we can accomplish more. The development of some of these industries which I have mentioned can be greatly assisted if the problems in connection with them are taken up by both the Department and the State experiment stations. It has been our policy in the past to obtain seeds in small amounts, but after having reviewed the results accomplished within the last three years I believe that better results can be obtained by importing somewhat larger quantities and exercising greater care in their selection and greater care in their distribution. The question for you to answer is, How much mutual assistance can we be to each other? Can the experiment stations, say in the macaroni wheat belt, which extends from North Dakota to Texas, undertake the development of the macaroni wheat industry? We have a comparatively large appropriation of money available for the purchase of seeds, but we can not devote all of this sum to the development of any one industry. The Department of Agriculture is a national affair, and the ground which we must attempt to cover is broader than that undertaken by the individual stations. I believe that the importation into this country and the establishment on a commercial basis of any new industry is one of the most profitable lines of agricultural work which can be undertaken, and I feel sure that if the State experiment stations will lend to the Department their hearty cooperation that in another decade we can materially cut down the amount of money expended by the people of the United States for agricultural products produced in foreign countries.

Besides the assistance which the Department will be able to render the experiment stations in sending out small quantities of seeds of new crops to be tested is that of being able to purchase for the use of the stations seeds of crops which have already been sufficiently tested, but which it is advisable to distribute in larger amounts. As an example of this latter policy I may mention that we have this year purchased for the use of the California Experiment Station 1 ton of seed of the white lupine, *Lupinus albus*. White lupine is well known and has been tried probably in every station in this country and without very flattering results, but in California it has been found to be of considerable value as a green manure. The seed is planted in the orchards and vineyards about the middle of September and covers the ground well in winter, supplying at the same time a soil cover and a nitrogenous fertilizer. Two years ago we purchased 5 tons of seed of *Vicia villosa* for the use of the Mississippi Experiment Station, and almost this entire amount was distributed among farmers whose names were supplied us by the director of the Mississippi Experiment Station. Another example is the distribution made last spring of sorghum seed of improved strains which have been selected for a number of years, under the supervision of the chemist of this Department, to increase their sugar content. Another is the distribution of sugar-beet seed which has been made for a number of years and which has passed largely through the hands of the State experiment stations. After a seed or plant has been experimented with, and if it is found to be better adapted to a certain region and a certain soil than the varieties now in general cultivation, I believe it to be a legitimate function of the Department of Agriculture to back up the work of the station where the tests have been made, and at the same time help the farmers by distributing these seeds in large amounts. However, after the seeds or plants have been taken up by the seed dealers, by the nurserymen, and the professional horticulturists, I believe that the debt of both the Agricultural Department and of the State stations has been paid, and no further distribution of that particular seed in that particular region should be made. We hope sometime to be

in such a condition that we can make arrangements with the various State experiment stations to have seeds grown for us for distribution, and this is one of the points on which I would especially like to have the advice of the agriculturists and botanists here present.

Discussion of the general topic of variety testing and plant introduction and breeding was introduced by W. T. Swingle, of the United States Department of Agriculture. The principal points brought out were:

(1) That an overwhelming proportion of the agricultural wealth of America is founded on the culture of plants and the breeding of animals introduced from other countries.

(2) That, as the industries founded on those introduced organisms become older, there is more and more tendency to replace the varieties introduced from abroad by those originated at home.

(3) There are enormous areas in America, especially in the South and in the arid and semi-arid West, which seem unsuited to any of the ordinary agricultural industries.

(4) To properly utilize these areas, as well as to better utilize areas now settled, suitable plants and animals should be introduced from similar regions in other parts of the world, and these organisms adapted to local conditions by breeding.

W. M. Hays, of Minnesota, also discussed this subject. The principal points to which he called attention were:

(1) How increased yields with new wheat have been made at the Minnesota Experiment Station by systematic and extensive selection; and also how the amount of variation toward good yield has been increased by crossing, resulting in even better varieties than those originated by selection alone.

(2) It was urged that cooperation between States interested in the same crops would not only save expense to each State in breeding new field and horticultural crops, but also that the betterment of varieties would take place more rapidly.

(3) The breeding of wheat has been carried on for ten years. The best new varieties improved by selection alone and tried for six years yield an average of 4.4 bushels more than the best of the original varieties used. In the case of varieties improved by crossing, followed by selection, an increased yield of 5.9 bushels, as an average for five annual trials, was produced.

(4) Other wheats, not yet tried sufficiently long in the field to give average, promise still larger increased yields.

(5) Definite results like the above, and especially those secured by the wonderful work of Luther Burbank, of California, and the work with cotton and oranges in the Department of Agriculture, should encourage the work of plant breeding.

S. A. Beach and J. G. Smith made brief remarks concerning cooperation between experiment stations and the United States Department of Agriculture in the work of introducing and testing seeds and plants.

The topic of grasses and forage plant investigation in experiment stations and the Division of Agrostology, of the United States Department of Agriculture, was presented by Thomas A. Williams, of that division, in the following paper:

Grass and Forage-Plant Investigations in the United States Department of Agriculture and the State Experiment Stations.

THE STATE EXPERIMENT STATIONS.

There was relatively little systematic investigation of the grasses and other crops supplying forage in any of the States until after the passage of the Hatch Act, making it possible to establish experiment stations in every State and Territory. In some of the older-settled portions of the country experiments had been carried on, either supported by the local government or by agricultural societies, but it can be fairly said that experimental grass and forage plant work in this country began with the establishment of the State experiment stations under the above-named act.

Investigations of grasses in the experiment stations have proceeded mainly along three lines. One, largely preliminary to the other lines and the first undertaken at a large number of stations, is that of the systematic study of the native grasses. This has usually been accompanied with observations as to the possible economic value of the different sorts. Naturally this line of work has been given a prominent place by the western experiment stations on account of the importance of the native-grass flora, regarding which relatively little was known. The second, perhaps classed more properly under ecology, has been carried on to a greater or less extent in the field in connection with the systematic work, and has developed rapidly in recent years in connection with the grass gardens established for the especial purpose of studying the different sorts in their relation to the surrounding conditions. The necessity for and value of such work both in the field and on the station grounds can not be questioned. The third, and the one perhaps the most important so far as the experiment stations are concerned, has to do more particularly with the direct economic importance of the plants, matters of cultural details, uses, etc. Under this third head the larger part of the work that has been done at the various experiment stations can be classed. It includes variety tests; the introduction of new sorts; the study of native varieties under cultivation and the solution of the various special problems peculiar to the section in which the stations may be located. Many of these problems are at once educational and experimental.

The lines of investigation carried on at the stations have been determined largely by two factors—the previous preparation and individual preference of the men having such work in charge, whether agriculturist or botanist, and the forage conditions and needs prevailing in the respective sections.

If the work was taken up by the station agriculturist it usually consisted first of tests of such varieties as could be obtained on the market with, later, such additional sorts as could be obtained from foreign lands through the Department of Agriculture, or by direct purchase or exchange. Sometimes, especially in the West, native varieties were included in these tests. After the first comparative tests of varieties, cultural methods naturally called for some attention, and this work has been extended in recent years at many of the stations to include the after care and treatment of the meadows and pastures, and the adaptibility of the crops to special uses, as for soiling, improvement of soil fertility, ensilage, etc.

In stations where the botanist has carried on the principal grass and forage plant investigations, the early work as a rule consisted of systematic studies in field and herbarium, chiefly of native sorts, followed by a bringing together of as large a number as possible into a grass garden, and later such as were of sufficient promise tested under field conditions.

Often both the agriculturist and the botanist were joined by the chemist, who made analyses of the different sorts. In more recent years the chemists and the agriculturists at some of the stations have devoted considerable attention to digestion experiments, using native as well as the common cultivated varieties.

Stations were often unable to undertake investigations through lack of funds, facilities, or properly trained men, and then, too, work undertaken had to be dropped for similar reasons. In many instances a great deal of injudicious work was undertaken, such as tests of varieties of which there was no reasonable chance for success, unnecessary duplication of experiments, etc. Successful grass and forage-plant investigations demand uninterrupted study and experimentation through a series of years, and the frequent changes of staff members and station policy occurring in some quarters have made it difficult to carry on such investigations, and in some instances it has been practically impossible to accomplish anything of value.

Among the first to undertake work along these lines was the California experiment station at Berkeley, and this station, under the direction of Prof. E. W. Hilgard, has done very much toward the introduction of valuable forage plants into that State by the distribution of seeds of many varieties. Other stations which have given special attention to grass and forage-plant investigations since their organization are those in Nebraska, South Dakota, Tennessee, Mississippi, Alabama, Ohio, Connecticut (Storrs), Kansas, Michigan, New York, Minnesota, Colorado, Texas, and North Carolina.

THE DEPARTMENT OF AGRICULTURE.

More or less attention was devoted to grass and forage plant investigations by the General Government in the first half of the century, but the work consisted chiefly in the distribution of a limited quantity of seed and the publishing of occasional articles in the reports of the Patent Office. One of the best of these articles was that written by the Rev. C. W. Howard on "Grasses of the South" and published in the Patent Office Report for 1860. In 1869 the late William Saunders established

a grass garden on the grounds of the Department of Agriculture, and cultivated therein 51 varieties of grasses and forage plants. This was extended later into the garden now under the management of the Agrostologist, where between 250 and 300 varieties are grown. Aside from this a large part of the early grass and forage plant investigations consisted of trips into different sections of the country made by Dr. Vasey, the botanist of the Department, and his assistants or special agents appointed for the purpose. In these trips the native grasses were studied with special reference to their forage value and possible introduction to cultivation, and reports were published from time to time giving the results of these investigations. In 1888 a special appropriation was secured from Congress for grass and forage plant investigations, and stations were established at Garden City, Kans., and also in connection with experiment stations in other parts of the country. The cutting off of this appropriation caused the abandonment of these investigations before the work could be brought to its most useful stage, but the impetus given to this line of investigation at the stations which were cooperating with the Department has had a most beneficial effect. For example, at the South Dakota station an experimental grass garden was established as a result of this cooperation, comprising about 5 acres of land, on which about 60 varieties of grass and forage plants, both native and introduced, were planted with a view to studying their adaptability to the prevailing conditions and the best methods of cultivating them. Although the cutting off of the Government funds caused the cooperation to be abandoned after the second year, the garden was maintained for more than five years by the station authorities with most valuable results. Other instances could be named of a like character.

The next important step taken by the General Government in the direction of grass and forage plant investigation was by the establishment in 1895 of the Division of Agrostology in the Department of Agriculture.

The law passed by Congress establishing the Division of Agrostology provided for "field and laboratory investigations relating to the natural history, geographical distribution, and uses of the various grasses and forage plants and their adaptability to special soils and climates; the establishment and maintenance of experimental grass stations; the collection of seeds, roots, and specimens for experimental cultivation and distribution; the preparation of drawings and illustrations for special reports, as well as illustrated circulars of information, bulletins, and monographic works on forage plants and grasses of North America." This law authorized work along technical or systematic lines, as well as lines of applied or economic agrostology. It made possible greater concentration of purpose and more systematic effort than had before existed, and gave due recognition to an agricultural subject of the greatest importance to the entire country. It afforded means for a wider distribution of the knowledge already gained by the Department and the State experiment stations, and rendered possible the undertaking of new lines of research and closer cooperation with experiment stations and individuals in future investigations. Immediately upon the establishment of this new Division, plans were laid for a vigorous and systematic prosecution of the work along the lines indicated in the act of Congress. In a country of such vast extent and varied character as the United States there were necessarily many problems relating to the forage supply that demanded attention, and the range of investigations, embracing both purely botanical work and the more practical questions relating to methods of cultivation, adaptation of varieties to local conditions, and the factors governing the forage supply of the different sections of the country, opened a broad and interesting field of labor.

As at present organized the Division includes four sections; one having charge of the field work and the collection and distribution of seeds; another the care of the herbarium, the determinations of material collected by our agents in the field or sent in for identification by correspondents; a third, the grass garden and the experimental work at Washington; and a fourth, the practical work outside of Washington, particularly as related to cooperative experiments conducted by the Division and the several experiment stations.

The field work of the Division is carried on in part by members of the regular staff, and in part by special agents appointed temporarily for work in particular sections. In this work the native grasses are studied in their natural conditions with respect to their geographical distribution, habits of growth, and their present or possible future value. Seed is collected of desirable varieties for distribution to the experiment stations, and in order that the plants may be grown in the grass garden at Washington. A special effort is also made to learn as much as possible regarding the soil and climatic conditions as related to forage production, and consultations are held with station workers, ranchmen, farmers, and others regarding the needs of the several sections and the best methods of supplying them. In many instances station workers are appointed as special agents to carry on these investigations and

this has proved a very fruitful line of cooperation. The grass garden is used more particularly as a means for studying the life history of grass and forage crops, both native and introduced, and for the selection and development of improved varieties. Doubtful species are grown here in order that the botanical characters may be more carefully studied, and seed of rare sorts, that can be secured in only limited quantities, is planted in the garden in order that a source of seed for future distribution and study may be made certain.

The experimental work connected with the grass and forage plant investigations outside of Washington has been carried on in cooperation with farmers, ranchmen, station authorities, and others interested in this work in the various sections of the country. During recent years, and particularly during the present season, special efforts have been made to bring this work as far as possible in direct cooperation with experiment stations. Heretofore the work with the stations has consisted chiefly in the distribution of seeds of varieties of grass and forage crops to be tested as to their suitability for cultivation under the conditions prevailing at the experiment stations. In a few cases, as with the South Dakota Station, the cooperation was of a more permanent sort, and had for its object the investigation of the problem of range improvement and the study of drought-resisting crops, questions of especial importance to the Northwest, the expenses of these investigations to be borne conjointly by the State station and the Department of Agriculture. This plan of carrying on the investigation of forage problems has promised such good results that it seemed desirable to extend it to other sections of the country, and Congress in its appropriation bill for the present fiscal year made it imperative that such work should be undertaken wherever possible. Accordingly special efforts have been made during the present season to place the work of station and departmental cooperation on a more permanent and systematic basis, and to this end personal visits were made to many of the stations and a great deal of correspondence carried on. Station men and departmental experts connected with the work of investigation realize the importance of a combination of funds, facilities, and working force to secure the most valuable and lasting results, and the plans of cooperation proposed have been such as seemed best adapted to bring about this end. All of the more important forage problems have a general as well as a local significance, and while it is recognized that the stations can best attend to the details of experiments and study them in their local bearing, the Department can do a most important work in broadening the scope of these investigations, unifying the methods of work and results obtained and applying them to the country as a whole.

The problem of range improvement is one which is admirably adapted to such cooperative investigation as outlined above. Over a considerable portion of the United States, west of the Missouri River, drought and overstocking have materially lessened the productivity of the natural ranges, and the ranchmen are confronted with the necessity of doing something to provide an additional supply of forage for their stock. While this problem of range improvement, in some of its different aspects, touches one of the most important industries in every one of the Western States and Territories, investigations that might be carried on in four or five representative localities would undoubtedly be applicable to all. It is therefore hardly necessary that each one of the Western experiment stations should undertake an extensive series of range-improvement investigations, as there would be a great deal of duplication, resulting in an unnecessary expenditure of time, labor, and money. In a similar way the problem of the formation, care, and management of permanent meadows and pastures is of vital importance to the Middle Western States, in which the raising of cattle and stock feeding is an industry of such magnitude. It would, however, be hardly necessary for each of the experiment stations in the States represented to investigate this problem in all its bearings, as experiments carried on at three, or perhaps four, would undoubtedly secure results that would settle the question for the entire section. It has therefore been a dominant idea in discussing the matter of cooperation to decide which of the more important forage problems lent itself best to station and departmental cooperation, and to unite the funds and facilities of both upon the solving of this problem, leaving others to be taken up at other stations. It is felt that this will allow the station men to plan their work to better advantage and to devote their energies more particularly to the details of experimentation, while the Department can assist in the matter of expenses, planning investigations, unifying results, and in fact handle the more general aspects of the question, and that on the whole much more can be accomplished than by isolated effort. Some of these special problems which are engaging the attention of station and departmental investigators, and the solution of which will undoubtedly be better accomplished through cooperative investigations are: Formation, care, and management of pastures; sand and soil binding grasses; a continuous series of soiling crops for the season; improvement of

native ranges and pastures; the growing of grass and forage crops as related to the improvement of the soil; forage crops for alkali soils; winter pasturage for the South; drought-resisting crops for the arid sections; pasture and meadow crops for high elevations; selection and development of varieties adapted to special uses and conditions.

SOME RESULTS OF STATION AND DEPARTMENTAL GRASS AND FORAGE PLANT INVESTIGATIONS.

Grass and forage plant investigations that have been carried on under the auspices of the Department of Agriculture and the State experiment stations have not only been of great importance in an experimental way, but are also of great educational value. The effect of these investigations upon the agriculture of the country is seen in the changed methods of farming that are being practiced in many sections. This is well illustrated in the South, where but a few years ago it was thought by many that the better cultivated grasses and forage plants could not be successfully grown. It is also illustrated in the improved methods of handling pastures and ranges that are coming into practice in the West, and in the greater diversity of grass and forage crops that are grown in almost all sections of the country where dairying is the leading industry.

It is hardly possible to enumerate specific instances of the valuable experiments that have been conducted at the various experiment stations, but a few may be cited to give an indication of the direction which these experiments have taken, and to show something of the progress that has been made. For example, it will be difficult to estimate the money value of the recent experiments with clovers and vetches at the Alabama Station; with cassava in Florida; smooth brome in California, Minnesota, South Dakota, and other stations; sorghum and Kafir corn in Texas, Kansas, and Nebraska; Japanese barnyard millet in Massachusetts; soy bean in Kansas, Massachusetts, etc.; alfalfa in Colorado, Wyoming, California, Louisiana, New Jersey, and elsewhere; the introduction and distribution of Turkestan alfalfa, smooth brome, and hairy vetch by the Department of Agriculture. These investigations, however, have been by no means confined to cultivated or introduced grasses and forage crops. The value of our native species, both in natural meadows and pastures under cultivation, has been investigated, and the results already obtained are not only interesting but of immense economic importance. A few examples may be cited: The brome grasses, wheat grasses, and some of the rye grasses for meadows; the gramas, blue grasses, and fescues for pastures; Terrell grass and other species of Elymus and rescue grass for winter pasturage in the South; saltbushes and saccatone for alkali soils; Astoria blue grass, big sand grass, and various species of Elymus for binding drifting sands; and many others that give promise of being adapted to special use in different parts of the country.

W. E. Britton, of Connecticut, read the following paper:

A VEGETATION HOUSE ARRANGED FOR POT EXPERIMENTS.

As nearly every horticulturist and botanist has frequent occasion to conduct pot experiments, either to solve problems in connection with the nutrition of plants or to test points in relation to other phases of plant life and growth, I will describe briefly an arrangement by which the work of such experimentation is greatly facilitated.

During 1894 a vegetation house about 19 feet wide by 27 feet long was erected for summer experiments. The house is high, being 15 feet from sills to ridge, and two continuous lines of ventilating sash at the ridge and one on either side near the ground give ample ventilation. A door in each end can be left open if desired. Both doors and all the ventilators are well screened, to keep out leaf-eating insects. Some experimenters remove the pots upon cars or trucks into the open air each day, but we have always preferred to keep full control over every condition when possible. The temperature in the house was a trifle higher than that outside, the average daily difference for 1894 being 3.6° F.

The house was originally provided with three benches, each being between 3 and 4 feet in width, upon which the pots were placed, sometimes in three or four rows. The plants are watered by weight and the water-content kept between 50 and 70 per cent of the water-holding capacity of the soil. The moving of 200 of these pots, weighing about 35 pounds each, to the scales involved not only a vast amount of labor but the crops were frequently broken by contact with those growing in adjacent pots, especially when removing cultures from the center of the bench. The house was described and figured in the Annual Report of the Connecticut Experiment Station for 1894, page 75.

During the past year this vegetation house has been remodeled so as to eliminate most of the danger and much of the labor in properly caring for the cultures. Instead of three wide benches, five narrow ones, each 2 feet wide, have been installed, leaving four walks, each also about 2 feet in width. These benches will each take two rows of pots and are fitted with steel track along the sides. Upon this runs a small truck carrying the scales, the top of the scales being level with the tops of the benches. For ease in handling we have adopted a convenient form of "express package scales," which weigh only 21 pounds, and have a capacity of 1 ounce to 50 pounds. The scales can be rolled along between the benches and a row of pots watered from each side, when the truck and scales may be transferred to the next walk, and so on through the house.

SECTION ON ENTOMOLOGY.

The Section on Entomology met at North Sheffield Hall, Yale University, New Haven, Conn., at 2 p. m., November 13, 1900.

Twenty-two members and visitors were in attendance.

H. Garman, of Kentucky, chairman of the section, called the meeting to order, and afterwards read the following paper:

Entomology in the Southern States.

In what follows, I am to be understood as dealing with the southeast part of the territory of the United States, including Virginia, the Carolinas, Georgia, Alabama, Louisiana, Mississippi, Tennessee, Kentucky, Oklahoma, Arkansas, and Texas. In a way it is marked off from the rest of the United States by the thirty-eighth parallel of north latitude on the north, and by the Rio Grande River on the southwest. Properly, the mountainous sections of Virginia, North Carolina, and South Carolina, Georgia, Alabama, Tennessee, Kentucky, and a portion of northwest Texas should be excluded, while southern Illinois and Missouri should be included, if the natural limits of the Austroriparian region, which I have in mind, are followed. I have selected this region for some special comment not alone because of an interest in its fauna and flora, aroused by ten years' residence in Kentucky, but because something, soil, climate, or what not, seems to have had an effect on human affairs within its borders; and it is chiefly my interest in this latter that has led me to select the topic.

The region possesses as much to attract the entomologist as any other part of the United States. The heavy forests which cover large portions of it, the tangles of undergrowth by which these are accompanied, its extensive swamps with characteristic vegetation, its shallow ponds, lakes, bayous, and streams give harbor and furnish sustenance to a variety of insects hardly to be found on any other equal area in North America. Florida, with her flora and fauna strongly South American in character, by herself offers an inviting field for years of study and exploration. Texas from her contact with the Central American States is a field not less inviting, and doubtless has much yet to tell us about Southern insects of which we know but little, and of Northern insects of Southern origin. Each of the States has special problems to be worked out with reference to the most common insects, problems whose importance is, I feel sure, not yet fully appreciated by Northern workers, but whose solution is as necessary to a complete knowledge of the entomology of this country as what has already been gained by work done in the Northern States.

Pioneer naturalists were not slow to get possession of the more abundant and striking insects from this quarter. Linnæus himself described some of the most characteristic, among which are the butterflies, *Papilio polydamus*, *Pieris monuste*, *Callidryas eubule*, *C. sennæ*, *C. philea*, *Heliconia charitonia*, *Agraulis vanillæ*, *Anartia jatrophæ*, and the beetles, *Dynastes tityus*, *Allorhina nitida*, *Tetracha virginica*, and *T. carolina*. Fabricius, Cramer, and other foreign naturalists, described many additional species obtained from correspondents in this country.

While these foreign naturalists were describing some of our most interesting species, notable work was done on the soil, though the results were often published elsewhere. Some of these early publications, treating of the natural history of the Austroriparian region, have scarcely an equivalent in quality and in the costly form in which they appeared for any other part of the country. What was in some respects a forerunner of the agricultural bulletin of the present day appeared in folio volumes in London

in 1731, 1743, and 1748, bearing the title, "The Natural History of Carolina, Florida, and the Bahama Islands, containing figures of Birds, Beasts, Fishes, Serpents, Insects, and Plants, together with their Descriptions in English and French. To which are added observations on the air, soil, and waters, with remarks upon the agriculture, grain, pulse, roots," etc. Catesby, it is evident, was something more than a mere naturalist. William Bartram's Travels through North and South Georgia, East and West Florida, appeared in 1791. A little later (1797) was published in two folio volumes Abbott and Smith's Natural History of the Rarer Lepidopterous Insects of Georgia.

In the early part of this century (1818) Thomas Say, the foremost resident American entomologist of his day, and one of the first this country has produced, with three fellow-members of the newly organized Philadelphia Academy of Natural Sciences, visited islands on the coast of Georgia, and the adjacent mainland, and also East Florida, for the purpose of collecting and studying the natural history of the regions visited. The trip was greatly shortened by the hostility of the Indians; but as one result there are scattered through Say's writings numerous descriptions based upon insects collected by him during this trip, or which were sent to him by people residing in the Southern States. Among the notable insects described by him from the South may be mentioned the chinch bug (*Blissus leucopterus*) of which he says, "I took a single specimen on the eastern shore of Virginia," and the curious harvest man, *Gonyleptes ornatum*, which Say collected on Cumberland Island, Georgia. So far as I know he published no paper restricted to insects from the Southern States, excepting one bearing the title "New species of North American insects found by Joseph Baribino, chiefly in Louisiana" which was published in 1832, and contained descriptions of 7 Coleoptera, 9 Hemiptera, 1 Hymenoptera, and 2 Diptera.

Dr. Hentz's work on North American spiders based upon studies made largely in North Carolina, Georgia, and Alabama during his residence in those States, though published from 1832 to 1850 (a supplement, edited by Scudder, appeared in 1867), is still unique in the literature of American entomology, no one before or since having devoted anything like the careful attention to the subject that was bestowed on it by this singular naturalist. Hentz, it seems, lived for a short time at Covington, in my own State, where he was engaged in teaching, but no evidence appears in his writings showing that he did any work on his specialty there.

Rafinesque, another naturalist with a reputation for eccentricity, lived for some years at Lexington, Ky. Considering the wide range of his observations on natural objects it is a little strange he should not have left his mark on the entomology of the region. The only publications bearing on the subject to which I find reference in a list of his published papers, are 2 on aphides, printed in the American Monthly Magazine and Critical Review in 1817, and bearing, respectively, the titles "Specimens of several new American species of the genus Aphis;" and "A second memoir on the genus Aphis, containing the descriptions of twenty-four New American species." In the latter part of his life, when his mind had lost something of its original quality, and when he was pressed by direst poverty, Rafinesque was disposed to take a utilitarian view of scientific investigations, and among other papers of a pseudo-scientific character issued by him during this period is one of interest to economic entomologists, since it traces back to 1832 the idea that sulphur placed in an auger hole made in the trunk of a tree is death to all vermin. The paper referred to appeared in The Atlantic Journal and Friend of Knowledge, pages 13 and 14, and is entitled: "Confirmation of the important discovery of the property of sulphur in trees to destroy all insects preying on them."

Philip Henry Gosse published a number of papers of interest to the student of Southern entomology, among which may be mentioned "Notes on a Voyage up the Alabama River" (Zoologist, 1844), on the "Insects of Jamaica" (Ann. and Mag. of Natural History, 1848), and "A Naturalist's Sojourn in Jamaica" (London, 1853).

Mention must be made in this connection also of the Cuban naturalist, Phelipe Poey, whose writings and collections have contributed much to a knowledge of Southern insects.

Nor should we overlook Charles Girard's paper on Southern insects in Marcy's "Exploration of the Red River of Louisiana in 1852." It contains the first scientific descriptions of the lubber grasshopper of the Southwest (*Brachystola magna*), of one of the largest centipedes (*Scolopendra heros*), of the millipedes, *Spirobolus ornata* and *S. atrata*, and of the tarantula, *Eurypelma hentzii*.

The names of others who wrote about this time will be brought to mind by those I have mentioned. Bracy Clark, Patrick Browne, C. Zimmerman, Haldeman, and others contributed observations and descriptions that would have to be included if anything like a complete list of writings on Southern insects were attempted. Those I have mentioned show that the region under consideration received rather more

attention from pioneer entomologists than other equivalent sections of the country, but it will be noticed that these authors are with few exceptions foreign born, and in some cases only transient residents of this country. This was to be expected, of course, of a new country. Those who were busy developing its resources had little time to give to the study of natural science, even if schools had been at hand where an education along this line could be secured. Such work as was done must of necessity fall to those who entered the field already prepared by education in foreign schools. The genuine native entomological product should, one would think, be forthcoming during the half century succeeding the issue of Girard's paper in 1853. Let us see what this product amounts to and who contributed to it.

I recall at this moment the following naturalists as having at some time during the past fifty years contributed in one way or another to our knowledge of the Southern insect fauna: W. H. Ashmead, George F. Atkinson, G. W. Belfrage, Rev. C. J. S. Bethune, Jacob Boll, S. B. Buckley, T. D. A. Cockerell, V. T. Chambers, E. D. Cope, E. T. Cresson, W. H. Edwards, A. R. Grote, L. Heligbrodt, H. G. Hubbard, Gideon Lincecum, Theodore L. Meade, Jerome McNeill, W. Schaus, R. W. Shufeldt, E. A. Schwarz, F. Sumichrast, A. L. Quaintance, and C. Zimmerman. To this list must be added the entomologists whose writings are more or less closely economic in character, and of these are to be named J. H. Comstock, E. W. Doran, Townend Glover, L. O. Howard, Gerald McCarthy, C. V. Riley, H. E. Weed, F. M. Webster, and most of the official entomologists now connected with agricultural colleges and experiment stations in Southern States.

Of the men named, V. T. Chambers, born in Boone County, Ky., near Cincinnati, is the only one known to me positively to be of Southern birth and education, though in all probability others were born and reared South. Chambers can not fairly be regarded as a Southern entomologist, however, for the reason that his birthplace and Covington, where he did his work on Tineidæ, is by climate a part of the Eastern zoological region. I am unable offhand to place all of the naturalists named, but from familiarity with their writings feel safe in saying that Bethune, Cockerell, Comstock, Cope, Cresson, Edwards, Glover, Grote, Howard, Hubbard, Meade, McNeill, Riley, Schwarz, Shufeldt, Quaintance, Webster, and Zimmerman are not Southern entomologists. Ashmead, of Jacksonville, Fla., is now residing at Washington. Atkinson, who described several new genera and species of trap-door spiders from the South in 1886, is a botanist, and resides at Ithaca, N. Y. Boll, Heligbrodt, Schaus, Shufeldt, and Sumichrast, from the form of their names, are foreigners, though I am unable to speak positively on this point. Including all as Southern entomologists about whose history I am uncertain, less than half of the men named were born and bred within the Austroriparian region. It would thus seem that the seed sown by Catesby, Abbott, Gosse, Rafinesque, Hentz, and Say has but little of it germinated. Probably the storm which broke on the States in the form of civil war cut down some of the young plants and kept others from fruiting. But I think this is not wholly responsible for the dearth of Southern entomologists, which has for years past characterized the Southern States. Nor does it appear to be due to a lack of interest in such matters by the general public. On the contrary, this interest has always impressed me as being more general and spontaneous among Caucasians at the South than among the same race elsewhere in the country.

The Practical Entomologist, published at Philadelphia in 1865–1867, contains inquiries concerning the names and habits of insects from correspondents residing in Kentucky, Virginia, Georgia, and other Southern States, which show that the journal was read and appreciated there. Agricultural and even ordinary newspapers published in the Southern States at this time contained interesting communications concerning rice and cotton insects. When the American Entomologist appeared in 1868, observers scattered all over the South took advantage of it as a means of learning about the insects, injurious and other, which they found about them. It is my impression that the editors were more frequently appealed to for information by Southerners than by the residents of any other section except the Middle West. The third volume (Vol. 1, second series) appears to have reached a still larger number of Southern people, if we may judge by the replies to correspondents and by several articles from the South, the growth of interest being stimulated no doubt by the activity about that time of our Government entomologists in studying cotton insects. But with all this promise, the bulk of the entomological work at the South is still being done by Northern men, and at the present time, including collectors, amateurs, professionals, workers of all sorts, the number of entomologists residing at the South is very small. The entomologists' directory published this year by the American Entomological Society, enables me to give some facts showing where most of our entomologists reside.

The State of New York, with its population (census of 1890) of 5,997,853, has 207 workers, one entomologist, using the word in its most liberal sense, for every 28,975 and a fraction of population, or, to put it in another form, one worker for every 237½ square miles.

Pennsylvania comes next, with 163 workers in a population of 5,258,014, making one for each 32,257 of population, or one for each 277⅝ square miles.

Then follows Massachusetts, with 133 workers in a population of 2,238,943, one for every 16,834 of population, and for every 62½ square miles of territory.

Illinois is fourth, with 81 workers and a population of 3,826,351, one for every 47,238.8 of population and every 691⅓ square miles of area.

Passing now to the group of Southern States with which I am chiefly concerned, we find Arkansas credited with 1 entomological worker, Florida with 2, Georgia with 9, Kentucky with 3, Louisiana with 5, Mississippi with 3, North Carolina with 7, Oklahoma with 2, South Carolina with 2, Tennessee with 5, Texas with 9, Virginia with 6, making a total of 54 workers for the 12 States, which is less than the number living in Illinois alone. These States have a total population of 16,113,727, and all together an area of 832,315 square miles, thus having 1 entomologist for each 298,402 of population and one for each 15,413 square miles of territory.

Distribution of entomologists.

	One entomologist to—	
	Population.	Square miles of territory.
New York	28,975	237½
Pennsylvania	32,257	277⅝
Massachusetts	16,834	62½
Illinois	47,238	691⅓
Twelve Southern States	298,402	15,413

We have seen that the region is rich in insect life of the sort most attractive to the systematic entomologist; that there are many problems of distribution to be settled by observation and collecting in all the States; that much valuable work remains to be done on life histories even of common species; and that a secure foundation in literature has already been laid. Added to these propitious circumstances is the fact that the resources of the Southern States are largely agricultural and their people chiefly engaged in farming and fruit growing. During the fourteen years immediately following the civil war, it is estimated that the loss from injuries by the cotton worm alone sometimes reached the sum of $29,711,000 for a single year. The boll-worm from its injuries to both cotton and corn is perhaps equally destructive. The rice weevils, so called, are additional spurs to the study of the economic side of entomology, as well as the scale insects of the orange, the harlequin cabbage bug, the tobacco worms, the various moths and beetles infesting stored grains and provisions, and a host of less well known pests. Probably the average annual loss from such depredations in the Southern States will not fall short of $40,000,000, much of which could be saved if information concerning the habits of these pests was more general among the people.

The work already done in the Southern States in the way of finding remedies has contributed greatly toward this result. It is believed that the loss from the cotton worm, for example, is at present not more than one-third what it was before the various spraying and dusting devices were brought into use, largely, it is held, as a result of the work of entomologists. A knowledge of methods of treating orange trees for scale and other insects has made similar progress. So that, with the importance of entomological studies constantly forced on the attention of farmers and fruit growers by the ravages of insects, with the encouragement offered them by the reduction of some of these injuries as a result of entomological investigations, together with the various allurements the situation offers to the entomologist himself, it would seem that these Southern States should become a veritable paradise for entomologists.

The tardiness with which this branch of science has developed is not due to the newness of the Southern agriculture, for that has been firmly established for a century. The conditions at the South are very different in this respect from those in the Western States, where the number of entomologists is also small. The figures with reference to the four Northern States recently mentioned seem to me to throw some light on the subject. Each of these States contains a city which ranks among the largest in the world. New York City furnishes 60 of the 207 entomologists in the

State. Philadelphia furnishes 56 of the 163 living in Pennsylvania. Chicago furnishes 42 of the 81 Illinois entomologists. Boston furnishes 22 of the 133 credited to Massachusetts. "Then it is city life that fosters the study of entomology," you will perhaps say. Yes, and no. New Orleans has somewhat more than half the population of Boston, yet has only 3 entomologists credited to her. Pittsburg with a population a little less than that of New Orleans is credited with 14 entomologists, and other Northern cities even smaller make a better showing than the chief commercial center of the South.

A striking feature of the lists of names of entomologists residing in these Northern cities is the large proportion of names with a foreign form, mostly German. Generally half or more are of this character, and indicate recent immigration. It is true of New York, of Philadelphia, of Pittsburg, of Newark, and of Chicago. Wherever recent German immigration has been great, there is found a large number of nature lovers and among them entomologists. The exception to the rule is Boston, whose list of 22 shows but two names, Minot and Ormonde, not exactly English in form; but at least one of these belongs to a family long established in New England. If recent German immigration accounts for the large number of entomologists in most of the Northern States, what is there in Massachusetts, where the conditions so far as this one factor is concerned are more nearly those of the Southern States, that takes its place?

Though one of the smallest of the States, Massachusetts is one of the first in population. And while it appears that mere numbers have but little to do with the question, it will be apparent that concentration of population is a more important factor. The close contact of minds engaged in the same line of business always stimulates growth. Competition becomes keener, and all available knowledge contributing to the greatest success is brought into use. When a State averages a little more than 269 people to each square mile of territory something is likely to come of it.

Then for years in the numerous villages of the State have lived and toiled men who cherish the ideals of Pestalozzi, the father of government education for the "great common people," and of Frœbel, the father of nature study. Louis Agassiz stimulated the growth of these ideas and exerted a powerful influence in persuading the general public to accept and make use of them. His influence was felt in Massachusetts as nowhere else in the country, and lives to-day in his numerous pupils and the great museum he founded at Cambridge. The influence of such men is becoming apparent in her numerous village libraries, where knowledge is almost as free as the air to her humblest citizen; in her admirably conducted kindergartens; in her State reservations; in the general fondness for plants, and birds, and everything else pertaining to nature; and, I might add, in the large number of entomologists she has produced, and the interest in the subject that has led to the establishment this year in her State agricultural college of the most complete special course in entomology, offered by an educational institution in this country. Now, it is just these ideas of Pestalozzi and Frœbel, which were brought here and propagated so successfully by Agassiz in 1846, that are coming now under the cap of the German immigrant. When he becomes established in this country the happy days he spent in his youth in the Fatherland, with companions and teacher, studying butterflies and plants in the fields, turn his thoughts to nature here. So when free for a holiday off he goes to the country with net and bottle and collecting box to experience again if possible the rapture he then felt when a new winged or unwinged beauty came to his hands. And there you have the German-American entomologist of our cities, always, without regard to the political party with which he may be connected, a staunch supporter of education for the masses, and a sincere friend of everything in the way of nature study.

In the Southern States, where there is but an average of about 20 persons to each square mile of territory, new educational ideas are disseminated slowly, and when they take root grow less rapidly than in the thickly settled States. Agassiz's influence was undoubtedly felt there, as is shown by the numerous specimens of Testudinata sent him by Southern correspondents. But the ideas he stood for have never in the South been appropriated and made use of as they have in the North. Nor has immigration of foreigners imbued with these ideas set strongly in that direction. So that old educational ideas brought from England have held their own there perhaps with more tenacity than anywhere else in the country. The advocates and exemplars of this education have, in my judgment, done more to retard nature study, and with it industrial growth in the Southern States, than all other agencies combined. Their prevalence explains why the entomological work relating to Southern States has been done very largely by Northern men. They dominate the teaching in private and denominational schools, and even public schools feel their

benumbing effect in the discouragement they place in the paths of those who would bring the youth into direct contact with nature. I need not stop to explain that the education to which I refer is the purely literary education given with the aid of text-books, based upon mathematics and history and capped by Latin and Greek; an education designed originally for a man of leisure and considered too good for the common people; an education that has led our young men looking for help and inspiration to shun England and flock to the schools of Germany, even though handicapped there by the use of a tongue not their own; an education that has ever led away from nature and from the affairs of the common people.

It was dissatisfaction with this same education that led to the establishment of our State agricultural colleges. Prof. J. B. Turner, of Jacksonville, Ill., who was perhaps the first in this country to suggest such schools, wrote in 1865: "During the thirty years that I was connected with the public schools and colleges, either as pupil or as teacher, and especially during the ten years of my professorship in an Illinois college, my mind was oftentimes oppressed with a sense of the utter inadequacy of our popular systems of education to meet the obvious wants of mankind, and especially of the people of the great West." Concerning an address which he delivered in 1848 or 1849 before an Illinois teachers' institute, in which he advocated special education for the farmer, mechanic, and teacher, he wrote somewhat later: "I was as much surprised and encouraged at the readiness with which the teachers there, and the people, seemed to fall in with and approve of that view of the case as I afterwards was at the vehemence with which many of the friends and advocates of the old classical system assailed, ridiculed, and denounced it as 'absurd,' 'revolutionary,' 'disorganizing,' and above all, utterly 'visionary and hopeless,' even if desirable. This, so far as I am aware, was the first time such a scheme of public education was ever proposed to mankind." The work of this able man and of others associated with him led to a series of conventions of farmers, mechanics, and teachers interested in the project; and their discussions finally took shape in a memorial prepared in 1853 and presented to the Illinois legislature, requesting this body to petition the National Government to aid in establishing industrial schools in all of the States. As showing the character of the men who had this project in hand, to remind you of the motives which actuated them and, if possible, to extend comfort to any who may have been made to feel that their work was alien to the purposes of these schools, and this by people it may be whose own right there is questionable, I wish to quote briefly from this memorial:

"We would respectfully represent that we are members of the industrial classes of this State, actively and personally engaged in agricultural and mechanical pursuits. We are daily made to feel our own practical ignorance and the misapplication of toil and labor, and the enormous waste of products, means, materials, and resources that result from it. We are aware that all this evil to ourselves and our country results from a want of knowledge of those principles and laws of nature that underlie our various professions and of proper means of a practical application of existing knowledge of those pursuits. We rejoice to know that our brethren in the several learned professions have to a good degree availed themselves of these advantages and have for years enjoyed their benefit. They have universities and colleges with apparatus, libraries, able and learned professors and teachers. * * * But we have neither universities, colleges, books, apparatus, nor teachers adapted or designed to apply even existing knowledge to our pursuits; much less have we the means of efficiently exploring and examining the vast practical unknown that lies around us." * * *

In the discussions at these conventions and the various memorials prepared by their committees it was made very plain that the proposed schools were not intended to further professional education, were not thought of as a means of equipping lawyers and doctors for their work; these people, they held, were already well provided for. Above all they were trying to get away from the study of dead languages, since it was largely a recognition of the failure of such studies to furnish the training and knowledge needed by working people that led to the movement for industrial education. They were on the whole courteous about it, too—did not disparage it as a training and preparation for others—but they wanted an education suited to them. And if anyone has a doubt as to what subjects they expected to be taught he has only to read the minutes of the meetings of these Illinois farmers and teachers held before the Morrill Act became a law, and published by the Illinois State commissioner of agriculture in 1865. It was to be a practical education—nature study—as opposed to the study of language, law, or medicine. However they may have got the idea, it was Frœbel's education—the education of the German immigrants—they were planting in our soil.

This is the kind of education supposed to be dominant in colleges established under

the Morrill law. But it seems that in some of them there must be a struggle for the supremacy of its ideals. When organized under the direction of men not themselves exemplars of this kind of training, the old classical ideals, while they may not be openly espoused, are sometimes, consciously or unconsciously, allowed an undue influence in shaping the work. This seems to be a period of reversion to ancient ideals, and we should perhaps expect sometime to be told that the farmers, mechanics, and teachers who begged for educational institutions of their own did not know what was best for them, and that their children are better off after all with instruction in Latin and Greek than with practical training in things calculated to be of use to them in their vocations. I fear the loophole offered by the words in the law implying that work alien to the main purpose of these schools is not absolutely prohibited will yet in some cases be taken advantage of to such an extent that their legitimate work will become subordinate to instruction having little relation to either agriculture or mechanic arts.

COLLEGE ENTOMOLOGY.

This brings me to the consideration of the position of entomology in the Southern agricultural colleges. The subject does not seem to me to be receiving the support there that it is entitled to. In some of these institutions entomology can not honestly be said to have a place. In most of the schools men capable of doing good work in entomology are employed, but in each case I imagine they are struggling against difficulties of the nature I have endeavored to indicate. That they will ultimately succeed in putting entomology where it belongs in most of these colleges I hope and believe, but they need, and I wish to bespeak it for them during this period of travail, the support and encouragement of entomologists and nature lovers everywhere. And I would remind these Southern entomologists that they belong where they are. These schools were founded for them. They are in their own domain as teachers and investigators if ever they will have one. No one has a right to say that ancient languages or even military tactics shall take a more prominent place in these schools than entomology. They have a right to the support of those in authority, and should stand up manfully for all the privileges which this right implies until every school in the Southern States has as well equipped an entomological department as the University of Illinois, Cornell University, or the agricultural college at Amherst. In doing this they will, I am sure, have the support and sympathy of the farmers of their several communities. These men think to-day as did the men who founded the schools. They know exactly where their interests lie, and are quicker than has sometimes been thought to recognize the schools in which these interests are carefully fostered and to distinguish those in which such interests are subverted.

The Southern entomologist who will keep constantly before him the purpose for which his school was founded, and will be guided in teaching and experimentation by the example of such men as Frœbel and Agassiz, with patience and reasonable ability, and the support of those in authority, has a future before him. But if he be one of those who Professor Forbes says "must have nature boiled in corrosive sublimate and fried in paraffin and sliced with a microtome before he cares for it," he is more likely to lead his pupils into the medical profession than to draw them out into the fields, and his proper place is in a medical school. For, while much is to be learned from such laboratory work, in an agricultural college a teacher has not done his full duty who has not impressed upon the minds of his pupils by opening the doors of his laboratory occasionally the fact that real scientific work can be done anywhere in the fields and woods; that education is not of necessity a matter of college buildings; that these are but convenient instruments, and that when he leaves school, however humble his occupation, he will find problems of importance to mankind lying close at hand waiting for solution.

It is especially in the interest of struggling entomological departments in Southern and Western States that I would say we can not afford to relinquish or slight our connection with this Association. We have something to do here as a body in their upbuilding that can not perhaps be as well done anywhere else. It is possible, also, that we might advance our special department of nature study all along the line by making a freer use than we have been doing of the opportunity here afforded us.

STATION ENTOMOLOGY.

This would be a good place to stop, but I recall a matter about which I expected to write when I began, and must beg your indulgence for a minute or two longer. Station work in entomology has not the same difficulties to contend with in the Southern States as has entomological instruction in this branch of natural science.

The field was unoccupied when the entomologist appeared. There was no remnant of "pedagogical despotism" here to bar his path, and his outlook at present seems to me very bright except when he is burdened with too much unrelated work. His opportunities for original work are exceptionally good. If I should make any criticism on the work already done, it would be that in the desire to do what no one has ever done before, possibly influenced by the complaint made before the work was fairly started concerning duplication of labor, he has avoided making careful records of the life histories of common insects for his locality. In my judgment such records will be among the most valuable contributions to a knowledge of American entomology that he can make. The life history of an insect in Massachusetts may be very different from that of the same insect in Alabama, and upon this difference may turn the question of remedies. With a full appreciation of the value of both kinds of work, I should say that for the present, and on the whole, this study of life histories should take precedence over experiments with remedies.

Then I think each Southern station entomologist should give us a good list of the insects of his State as a contribution to a knowledge of the geographical distribution of our insects. The insects of staple crops, such as cotton, rice, and tobacco, and of the orange and other Southern fruits, are subjects of study which properly fall to the share of Southern entomologists, and must receive their close attention. The work already done by Ashmead, Comstock, Hubbard, Glover, Riley, and others, valuable as it is, has not by any means exhausted the subject. These things I know are receiving attention, and will ultimately be exhaustively treated.

In general I feel so well satisfied of the future of station work in entomology that I am willing to leave the subject with this brief mention. But in concluding I must return to the main theme of my paper to say that instruction in entomology in Southern agricultural colleges ought to be advanced.

W. E. Britton, of Connecticut, presented the following paper:

Observations on the Banding of Trees to Prevent Injury by the Fall Cankerworm.

During several years the trees upon the station grounds had suffered an annual defoliation by the larvæ of *Anisopteryx pometaria* Harr. Not only were trees of apple, plum, and cherry attacked, but large hickories and chestnuts were considerably damaged. It was not considered feasible to spray these large trees, as a special outfit containing a powerful pump would be required, and we finally decided to test the efficiency of bands coated with various substances. Accordingly, in September, 1897, all trees on the grounds which had previously suffered injury by cankerworms were banded. The materials adopted for bands consisted of a 5-inch strip of common black tarred roofing paper tacked around the trunk of a tree outside of a strip of cotton batting, and some sticky substance placed upon the paper. The cotton batting was cut into strips, and a strip placed around the tree and fastened with a single tack. The paper was then drawn loosely around the cotton and fastened where lapped with three tacks. On a large tree a tack through the opposite side is necessary to hold the band in place. The cotton prevents insects from crawling beneath the paper band, and at the same time allows the tree to increase in diameter without breaking apart the paper. The sticky substance was first applied in a layer about one-fourth of an inch deep around the upper portion of the band, leaving the lower edge of the paper uncovered to receive the ink if it should run on warm days.

Of the fifty-five bands put on as described above none needed renewing for two years. During the third season new cotton and paper were needed in several cases where the old bands had been broken by the growth of the tree or torn off by storms. Fully one-half of the original bands, however, are now doing duty for the fourth season.

For coating the bands, tree ink, pine tar, and a caterpillar lime were at first employed. The first was the most satisfactory, as it remained sticky for a longer time and did not penetrate the paper or the tree to as great an extent as the other substances. Several small fruit trees were injured by the pine tar and the caterpillar lime. The tree ink is ordinary printer's ink made up of "odds and ends" of different colors and grades left over from job work. It is put up in 10-pound cans and sold for tree purposes, and costing about 15 cents per pound. This ink has a tendency to become hard on the outside in very cold weather and we looked about for something that could be used in connection with the ink to keep it in better condition. A local oil dealer advised a mineral oil known to the trade which is used as a lubricant for the axles of freight cars. A single gallon was purchased for 25 cents. This oil is non-drying and does not thicken with the cold. When mixed with the ink the combina-

tion remains sticky for a long period, and when it finally becomes a trifle hard a brush-coating of the oil restores it again to a sticky condition. The oil, when used alone as a coating for the bands, is not viscid enough to stay in place, but collects on the leeward side of the tree during a storm.

Though the bands were at first applied during the month of September, according to the advice sometimes given in books, I have never seen the adult moths before November, and usually they do not emerge until a warm day after the ground has been frozen. They are also seen on warm days during December and January. The bands must be kept viscid also through the spring and early summer, or the caterpillars will ascend after the eggs hatch. A strip of wire netting tacked by its upper edge around the tree and making a small angle with the trunk was also given a trial and is quite as effectual as a sticky band in preventing the ascent of the females; but the young caterpillars, immediately after hatching, crawl through the meshes and up the tree.

It is certain that by the use of such bands as I have above described the ravages of the fall cankerworm may be largely, though perhaps not entirely, prevented. At any rate, the foliage is not rendered unsightly by its attacks. Many other leaf-eating insects are also kept away from the trees.

In reply to a question by S. A. Beach, of New York, Mr. Britton stated that he had used wire netting; but where eggs were left under the trap the young hatching in April usually went through it.

Mr. Beach referred members to Mr. Slingerland's published account of the netting.

H. T. Fernald, of Massachusetts, said very little was known of the fall cankerworm. He stated that the pest was being studied at Amherst, and results would be published as soon as completed.

E. P. Felt, of New York, then presented the following paper:

Suggestions toward Greater Uniformity in Nursery Inspection Laws and Rulings.

The purpose of this paper is to provoke discussion of the subject under consideration and thus lead to a better understanding as to what is most practicable in nursery inspection and in the regulations governing the same.

The San José scale is now so generally established in the East that exterminative measures, that is those directed toward the eradication of the pest from even a State, are out of the question, though its dissemination should be prevented by all possible means and its control in all places earnestly advocated. This question should be approached from the practical as well as the scientific side, and our enthusiasm balanced by judgment.

A number of the States have laws governing the inspection and shipment of nursery stock. These laws vary considerably, but I fancy that there is no greater discrepancy between their wording than there is between the interpretation of the word "inspection" in the various States. Certificates of inspection are said to possess little value, but that depends somewhat on the man granting them. We can probably all agree that an annual or even semiannual inspection of all marketable nursery stock should be made by a competent man. How thoroughly should this work be done and who should pass on the qualifications of the inspector? It would seem that every tree should come under the inspector's eye, preferably when it is leafless. This may seem a trifle unnecessary in large blocks where all the trees appear as clean and smooth as one could ask, yet it is the only satisfactory method. The inspector or his assistant should go through the nursery, taking but one row, and having at his disposal time enough so that every suspicious appearance can be investigated. The actual method of inspecting a tree and the time necessary must be left in great measure to the judgment of the man doing the work. The inspection of nursery stock should be performed by a person having some entomological training, at least, and the more the better. He should be able to recognize at sight our common scale insects, and he should belong to the class which is always willing to investigate and learn. Experience soon makes a competent nursery inspector a specialist along his line, and it is a source of pleasure for me to record that men possessing the natural qualifications and without a college education have been known to do just as well as college-bred men. This statement is not made for the purpose of reflecting on the value of a collegiate training, but to point out another field of activity for enterprising young men who may not have had this advantage. The foregoing indicates that

nursery inspectors should be appointed on account of their natural qualifications and knowledge of the pests to be met in a nursery. No persons are better able to pass on these qualifications than those who have been studying the general subject for years. The position of nursery inspector should never be under the control of politicians.

The certificate has value in proportion to the thoroughness of the work behind it. There are not, and I doubt if there ever will be, enough strictly professional entomologists to inspect annually all marketable nursery stock. Much of the actual inspection will probably always be done by men appointed for that purpose. The work of inspection is usually carried on in the various States either under the direction of an official entomologist or a secretary or commissioner of agriculture. The entomologist, if one be in charge of the work, may do some of the actual inspecting, but this does not hold with the latter officer. The certificates are usually signed only by the person in charge of the department, and the individual doing the work is kept out of sight. True, the inspector is responsible to his superior; but would not the work be of a higher grade if the inspector was also required to attach his signature to the certificate? It seems to me that it would. This is not a sovereign remedy for unreliable certificates, but it is an additional safeguard; and the presence of the signature of the man who actually inspected the nursery stock would increase the value of the statement. There would be a sense of individual responsibility on the part of the inspector that could not otherwise be obtained.

Now we come to the question of the control of nursery-inspection work. In whose hands should it be placed? The first impulse might be to put it in charge of the official entomologist of the State. He is an executive officer in some States, and in those such should be the rule; but this does not necessarily apply to Commonwealths where the enforcement of agricultural law is placed in the hands of a secretary or commissioner of agriculture. Much of nursery inspection is of the nature of police duty, and where a scientific man is released from such labor he should be the last to complain. Nursery inspection can be wisely carried on under the control of a man not pretending to have any training in entomology; and where such is the case, as in New York State, it is a pleasure for a scientific man to give such assistance as is possible. There may be States where nursery inspection under such an officer lacks vital essentials, and where that be the case the people should be properly instructed, and in time the evil will be remedied.

States having laws controlling nursery inspection usually prohibit the shipment of trees into or about the State unless accompanied by a certificate stating that inspection has been made and the nursery stock found apparently free from dangerously injurious insects, or words to that effect. A printed duplicate is usually sufficient to pass such stock, but some States require the filing of a signed certificate, and on this basis a number of copies of a certificate are issued by the local authorities to the parties desiring to dispose of stock in the State. This arrangement enables authorities to scrutinize more closely the character and methods of inspection in vogue in other States and is perhaps the best that can be devised, though it frequently necessitates the use of two certificates, one for shipment out of the producing territory and the other for the purchasing State. Some State authorities accept any certificate known to be issued only after a thorough inspection has been made, and if a close watch is kept to prevent the shipment of nursery stock under certificates issued by careless or irresponsible persons there is less trouble for the nurseryman and dealer. It would be an easy matter when an official is in doubt as to the value of certificates issued by certain parties, to ascertain through inquiry, either of official entomologists connected with the United States Department of Agriculture or of a State official. I am not in favor of absolute, unbending rules, though it must be admitted that without such there is some danger of laxity. At least one State has gone so far as to admit stock on nothing but a certificate signed by an official entomologist. It would seem that if an official entomologist indorsed the inspection in question, nothing further could be gained by requiring him to actually sign the certificate.

There is undoubtedly some abuse of the certificate, and this is very difficult to prevent. Still, if inspection of all nursery stock is made compulsory in every State, the chance for such abuse is materially lessened.

We all agree that nursery stock infested with San José scale should be treated in some way, and probably most of us would insist on the destruction of all badly infested trees. How about the others? They should at least be thoroughly fumigated with hydrocyanic-acid gas before shipment, and preferably held over a year and watched, in order to make it more certain that all the scales have been killed. All practicable precautions should be taken to prevent the dissemination of the pest. We all agree that one of the best methods of accomplishing this end is the fumigation of all nursery stock with hydrocyanic-acid gas before shipment. I understand that a large proportion of Maryland nurserymen do this as a business precaution. Last winter there was

an attempt made to amend the New York State law so as to compel the fumigation of nursery stock, but it failed. There are already a number of nurserymen in the State who make a practice of fumigating their stock before shipment, believing it to be good business. General fumigation can most certainly be approved, not only because it destroys the San José scale, but on account of its preventing in a large measure the dissemination of other undesirable insect pests. The public is fast becoming aroused to the possibilities of carrying insects on young trees, and while no one would do a nurseryman the injustice to suppose that these insects are either protected or their destruction neglected by him, still there is a strong desire on the part of leading horticulturists to have this danger reduced to a minimum. In other words, there is a growing demand for fumigated trees, and the indications are that in time the dealer who would retain a first-class trade must fumigate his trees. I think the entomologists of the country very generally recognize the utility and desirability of fumigation. Should we take a more advanced position? It seems to me that when we have pointed out the dangers of the situation and shown the advantages of this method, our duty to the public has been discharged. If there be an apparent conflict between the interests of the nurseryman and the horticulturist, it is not for us to take sides. No fruit grower is debarred from purchasing fumigated stock or prohibited from treating it as he desires after it becomes his own. It is very true that he may suffer through a neighbor's carelessness or indifference, but that can not be helped till public opinion is strong enough to enforce a fumigation law after it is placed on our books. I believe our business is to educate the public rather than attempt to influence legislators.

Another question which is bound to come up in this connection is the treatment of fruit infested by San José scale. This insect is present in a number of orchards in various parts of the country, and more and more scale-infested fruit is likely to find its way on the market. It is very true that we have no authenticated instances of the pest becoming disseminated in this way, but it is perfectly within the possibilities. There is much less danger, comparatively speaking, from fruit sent to large cities than from the apples which may be picked up by the omnipresent boy, who may carry them some distance and then test the accuracy of his aim by throwing them at trees. It would be the easiest thing in the world for young from a bearing female to crawl from such fragments onto a clean tree. In years of local scarcity, infested fruit might be shipped into a clean locality and sold in homes surrounded by a few trees. Then only the boy is necessary to complete the story, and he is usually present. I do not wish to cause a scare, but these conditions must be considered. We should recognize this danger and be prepared to suggest a remedy. The horticultural interests of some sections of our country are immense, and in others the growing of fruit of any kind is of little moment. A law of great importance in one section may not be desired in another, and yet an industry should be afforded legitimate protection. I believe this can be brought about only, if it be desirable to seek aid from the law, by adopting an act which may be local in operation. One similar to that in force in California, where a certain number of property holders can petition the county supervisors for the appointment of a local board of commissioners, who have the necessary power to deal with the situation, is good, or it could be placed in the hands, with discretionary powers, of the authorities charged with nursery inspection. There should certainly be some means of regulating this traffic.

To summarize briefly, we should insist on thorough inspection annually of all nursery stock by competent men. This work can be done best when the leaves are off the trees; and we recommend that the certificates be signed also by the men who do the inspecting, thus emphasizing personal responsibility. Nursery-inspection laws may be very well enforced by authorities charged with the execution of agricultural laws. It would be well if certificates issued or vouched for by official entomologists were accepted in all States. Nursery stock badly infested with San José scale should be destroyed, and that having a little, thoroughly fumigated with hydrocyanic-acid gas, since this treatment is a valuable safeguard, even if stock is not known to be infested. Fruit infested with San José scale should not be shipped over the country without treatment; and it is advisable, where necessary, to have the law so amended as to give discretionary powers in the matter to the authorities charged with administering the San José scale law.

W. G. Johnson, of Maryland, then read the following paper:

Experiences in Nursery and Orchard Inspection.

The conditions that have made nursery and orchard inspection necessary are well known to the members of this organization and need not be repeated here. I believe the first and one of the most important parts of inspection work is the good will

and confidence of the nurseryman and orchardist. With the hearty cooperation of these men the inspector can accomplish much good, but without it his work is of little value so far as the individual or general public are concerned. In my nursery-inspection work I have had the help and assistance of all Maryland nurserymen, from the beginning of the work in 1896. I have endeavored to study their interests, and at all times drop a timely suggestion here and there when I could do so. In four years I have seen marked improvement in methods of propagation, cultivation, and general care of nursery stock in many nurseries. At first I found many out-of-date methods being practiced; now we have a system of uniformity in budding growing, and packing. This marked improvement in conditions has been accomplished without the slightest difficulty, although it has taken nearly four years to perfect it.

At first only one visit was made during the year to each nursery. Realizing that this was not often enough two inspections were made, and in many instances, three or more, as conditions seemed to warrant. I do not believe one annual inspection is sufficient unless made very late in the summer. So far as the San José scale is concerned, an inspection made before the first of June is of little or no value to the nurseryman or the man who buys the trees. The scale rarely begins breeding in the Northern and Middle States before the first week in June. If perchance it had been budded in peach, it would be practically impossible to detect it at that time. The heavy broods of scale occur in August and September, or even October.

Considering everything, I prefer late summer or even fall and winter inspection. The scale is much more easily detected when the leaves are off. Where such trees as pear and apple, that stand in the nursery row two or more years, are found, the inspection can be best done after the leaves fall in the autumn, or in the spring before the leaves appear. In case of peach, the most difficult and unsatisfactory of all nursery stock to inspect for scale, the midsummer or autumn inspection is preferable. The inspection of June-budded peach and plum is difficult and unreliable in the nursery row; they can be inspected properly only after they are dug.

The disposition of infested stock, when detected, varies according to different State laws. In Maryland, when a tree is found containing one or a thousand scales it is condemned, dug up, and burned. This rule has been strictly enforced. In New Jersey, according to Dr. Smith, there is no law compelling a nurseryman to destroy infested trees even if they are detected. In a recent paper he cited an instance where scale was found in a small nursery and a certificate was withheld. Yet this same nurseryman sold every one of the trees, scale and all. Such a law is of no practical value unless the inspector has the power to have destroyed all infested stock.

I do not believe that only specific diseases and insects should be stipulated. The power of the inspector should be such that he can include any pest, disease, or insect that may be found and considered dangerous. There has been much discussion about the form of certificate. I have adhered closely to the first one adopted by us, and which, I believe, covers the conditions very thoroughly. A copy of the present form used by us is as follows:

CERTIFICATE OF NURSERY INSPECTION.

No. ———.

To whom it may concern:

This is to certify that on the —— day of ———, 189—, we examined the nursery stock of ——— ———, growing in ——— nurseries at ——— ———, county of ———, State of Maryland, in accordance with the laws of Maryland, 1898, chapter 289, section 58, and that said nurseries and premises are apparently free, so far as can be determined by inspection, from the San José scale, peach yellows, pear blight, and other dangerously injurious insect pests and plant diseases.

This certificate is invalid after ———, 189—, and does not include nursery stock not grown within this State, unless such stock is previously covered by certificate and accepted by the State entomologist and State pathologist.

———— ————,
State Entomologist.
———— ————,
State Pathologist.

College Park, Md., ———, *189—*.

Experience has taught me that it is unsafe to say that the scale has been exterminated in any locality, especially where it had been once established. It is always sure to crop out again where one least expects it. Old trees that are treated must be inspected regularly each season. Osage orange hedge fences are a veritable nui-

sance in the vicinity of an infested orchard. An inspector may go through a young orchard of a few years' standing and not find a single scale; but the next year he need not be surprised to find certain trees literally incrusted with it. Where only a few trees are found infested in a young orchard, it is not difficult to hold the pest in check.

The disposition of infested trees is not always an easy matter for an inspector to solve. If very badly infested and of no practical commercial value, the axe and fire are the easiest solution. But if treatment is necessary many things must be considered. The owner may not be in a position to go ahead with the work at the proper time. The trees may be in such a condition that spraying can not be conducted properly. In all it is not an easy task for an inspector to handle an infested orchard. It is far easier to handle an infested nursery, as here he can inspect and destroy and secure himself and the nurseryman by the fumigation of all suspicious stock. A tree on which scale is found should never be fumigated, but burned. I have repeatedly stated that in the eyes of a fruit grower a dead scale detected upon a tree was just as demoralizing to the nursery trade as a live scale. On that account no scaly trees should be sold under any circumstances.

That some nurserymen have abused the certificate system has been cleverly detected in some cases. Yet, on the whole, a certificate represents a great deal, if the grower considers all things. In addition to a certificate issued by an inspector, he should have the power to quarantine any lot of stock considered suspicious and compel fumigation under his direct supervision. I believe in and advocate fumigation in any event. The conditions are such that there is great danger of scattering the scale, as well as other dangerous pests, from almost any source.

J. B. Smith, of New Jersey, read the following paper:

Nursery Inspection.

In the matter of nursery inspection one of the most important points is that the examination should not be made too early in the season. A certificate bearing date before the middle of June is not worth the paper it is written upon, because in the latitude of New Jersey the scales do not begin to breed before that time. A peach nursery examined in June, before the scales had begun to breed, would have to be examined bud for bud in order to make sure that none of those put in the summer before had scales attached to them. It is obvious at once that this can not be done with any degree of thoroughness. Strictly speaking, no nursery should be examined until after September, and preferably not until after October 1. Some of the heaviest broods come after the 1st of September, and nurseries that are anywhere near an infested area may have trees clean at the beginning of September and generally infested by the middle of October. It is thus quite possible that a certificate may be given to a nursery when it was apparently free from injurious insects, and that this certificate may be a false one at the time the trees are actually shipped. Personally, I try to postpone the inspections as late as I can, and except under unusual conditions no examinations are made prior to the 1st of September.

While the San José scale is, of course, the chief insect sought for, nevertheless the attention of nurserymen is also called to insects of other character that are likely to prove troublesome, and in my own practice the occurrence of a sinuate borer in pear stock will as completely debar a nursery from a certificate as the pernicious scale itself. I always insist upon the destruction of every tree showing this borer.

It is difficult to guard against the distribution of infested stock, even under certificate. All nurserymen deal more or less, particularly where they have a large trade. It is a practical impossibility for them to grow all kinds of stock. Many varieties they can buy much more cheaply than they can grow, and almost every section is especially adapted to growing some one particular type of stock. So we grow peaches in New Jersey that are sold by nurserymen throughout the Western States, and so we buy apples from the West and North for sale to our own people and to their customers. It sometimes happens that stock bought in this way proves to be more or less infested, and it is sent out under the certificate given to the nurseryman. This is quite legitimate, provided the stock has been received under certificate, and yet it offers a chance for the spread of infested material. New Jersey has so many points of entry on railroad lines along its western and northern border and by steamship and other lines on its seacoast that it is practically impossible to police so as to prevent the entry of uncertificated stock.

It has been the practice also on the part of some nurserymen to attach a declaration of their own in the form of a certificate, which will pass as such to the ordinary freight agent, and even in the hands of a purchaser; so nominally or apparently stock comes in under certificate which may yet be infested by injurious insects.

It goes without saying that the examination of individual trees in a nursery is an impossibility. We must examine the surroundings of the nursery to see that there is no point from which infestation can conveniently come from the outside, and one of the first questions I always ask a nurseryman is: "Where did you get your buds, grafts, or scions?" If I can get at the trees from which cuttings were taken, I devote as much attention to their examination as I do to the trees that were budded from them, and after I have been on a nursery for two or three years in succession and have assured myself that the parent stock is clean I devote most of the time to the examination of stock budded from outside sources.

It seems a hopeless task at first to say whether or not scale insects are present in a large peach nursery. Nevertheless, from the practical standpoint, I have been often surprised to find how easy it was to spot an infested tree in a large area. If scale is discovered, the question at once arises as to where it came from, because, knowing the source of infestation and the time at which the insect came in, we may often eradicate it with comparatively little trouble and at a sacrifice of a very small area of tree stock.

Left-over purchased stock is always a source of danger, and I am discouraging the keeping of such stock any longer than is absolutely necessary. I advise all nurserymen to clear their blocks completely, and if they have unsold stock which they wish to keep over to run it in by itself, away from their young trees. It is easy then to keep an eye upon this old stock, and if any appearance of injurious species develops upon it it will not be likely to spread from that point.

I have urged upon nurserymen the importance of erecting fumigating houses, and most of our larger dealers have adopted my suggestion. I have advised fumigation even where no scale is present against such insects as root lice on peach, woolly apple louse, and the like.

Our law does not require certificates for trade within the State. There are a large number of small growers who have only a few thousand trees, principally peach, which they sell to farmers in their own vicinity. Many of these grow fruit as well, and it is from such points as that that a large portion of the recent spread of the scale in northern New Jersey is due.

H. T. Fernald said the San José scale had been found in thirty-three places in Massachusetts, practically covering the entire State, and that it was difficult to say what should be included in a certificate. He asked whether it should not include the gypsy moth, the brown-tail moth, the West Indian peach scale, as well as the San José scale in Massachusetts. He stated that the gypsy moth was in some nurseries. He thought it a difficult problem to handle.

W. G. Johnson thought that a certificate should be so worded as to cover any insect or disease of a dangerous character found in a nursery, and that the State officer or inspector, as the case may be, should be the judge as to what should be covered by his certificate.

J. B. Smith said he inserted in all certificates the following: "It is apparently in a healthy condition."

With reference to certificates, S. A. Forbes, of Illinois, said that recognizing the fact that a substitution of certificates was inevitable he had formally authorized it, issuing to nurserymen a list of accredited inspectors and giving general permission to substitute his own office certificate for that of any or all of the inspectors on this list; a clause of the Illinois law warranted him in doing this.

W. G. Johnson said that it was difficult to keep track of the official inspectors, and while a name on a certificate one year might be all right it would be invalid the following season.

C. W. Woodworth, of California, thought that there was too much political influence being pushed into nursery and orchard inspection.

Other members were of the same opinion.

W. G. Johnson then read the following paper:

Recent Results with Hydrocyanic-Acid Gas for the Destruction of Insects in Large Buildings.

In the American Miller for March, 1898, I published an article upon the cockroach in a North Carolina mill and made the following statement: "We are going to try a new remedy. It has never been used, to my knowledge, for destroying

insects in mills. It is simple and easy to apply, but a very dangerous and deadly poison and must, like dynamite, gunpowder, kerosene, or bisulphid of carbon, be handled cautiously and by expert hands. Our new remedy is hydrocyanic-acid gas, the most deadly poison known. I have used this gas in my experimental work for the past two years for killing insects upon young fruit trees, nursery stock, and in bearing orchards with marked success. I have also used it in buildings for destroying rats, where they were troublesome, and I am now going to apply it to the modern mill and storehouse, and my candid belief is that it will be the coming remedy for all vermin, including rats and mice, within inclosures."

The opportunity did not offer itself at that time for the experiment, and we were obliged to let the matter drop. This spring of 1899, however, I did have a chance of using the gas in a granary and storehouse. My results were so gratifying, I decided to apply the method to a modern mill, if I could find one infested with insects, and could get the consent of the owner to poison his bugs. I asked for the material to perform some experiments in my laboratory, and it came from Canada and Mexico, New York and California and many places between.

I soon found two infested mills where I could try the gas on a large scale. Both mills were three stories, with basement and attic. One was 70 by 42 feet and the other 50 by 50 feet. Before filling an entire building with gas, we decided to confine our experiment to one floor. All arrangements were made with a Pennsylvania miller, and final directions were sent. The first charge was set off June 10, 1899, using for the purpose 5 pounds of potassium cyanide. This was at the rate of 0.10 gram of cyanide per cubic foot of space. June 15 I received the following report from the owners:

"We made use of the chemicals sent us, as directed, on the 10th instant, and had some success, at least enough to convince us that through its use we can retain possession of our mill. Most of the weevil on the first floor are either on the floor or very close to it, and we find that a good many of them escaped punishment. In the rooms above the first floor we will have a better chance at them, they being higher up in places where we can not get at them with anything but gas. We would like to have you arrange to send us enough of the potassium cyanide to go through our mill from the first floor up. Any information you can give us concerning the second treatment will be greatly appreciated. We found a dead cat on the mill floor when we went in after airing the room thoroughly."

This experiment was thoroughly satisfactory, and being the first of the kind ever tried in a mill, so far as I know, is of special importance. Where only a single floor is fumigated we would naturally expect some insects in the floor and beneath it to escape the gas, as the gas is lighter than air and rises. A room therefore would have to be perfectly tight and enough gas generated to fill it before the fumes would reach the floor and penetrate the cracks and crevices. It would be only a few moments after fumigation before the insects would again come through the cracks in the floor from the basement below.

To be successful in the greatest degree, the mill should be thoroughly filled at one time with the gas. For instance, if only a single room or floor is used and the gas is generated, the insects become very uneasy when they begin to feel uncomfortable and run here and there in search of a crack through which to escape, but if every room is full of gas there is no possible means of escape except through some crack leading out doors.

In an Ohio mill, June 20, we tried another experiment on one floor only, using 10 pounds of cyanide. This was at the rate of 0.12 gram per cubic foot of air space. The chemicals and all were placed according to my directions in the hands of an expert chemist. June 30 the owner sent me a sample of web and material from the room, and wrote as follows: "I send you by mail under separate cover a sample of moth weevil and bugs that the preparation (gas) destroyed. I wish to thank you for what you have done for me and to tell you that the experiment was a grand success."

I made a careful examination of the material and found seven species of dead insects as follows: (1) Flour moth, *Ephestia kuehniella*, adults and larvæ; (2) bolting cloth beetle, *Tenebroides mauritanicus*, adults; (3) American meal worm, *Tenebrio molitor*, adults; (4) flour weevil, *Tribolium confusum*, adult and larvæ; (5) black carpet beetle, *Attagenus piceus*, adult; (6) a lady beetle, and (7) a hemipterous insect. The latter two were, no doubt, feeding upon some soft bodied creatures, as they are both predaceous.

This web, flour, dust, and insects was placed in a breeding cage and was under daily observation for three weeks and no life made its appearance. When the package was received I found one living specimen of the flour weevil, *Tribolium confusum*. It was, no doubt, a straggler from some crack where the death atmosphere did not reach.

I am receiving a great many interesting letters from millers who have successfully used hydrocyanic-acid gas in their mills. Every letter is full of confidence that we have discovered the right thing for pests in mills. I quote herewith a letter from one of my Western correspondents:

"Noticing your article on hydrocyanic-acid gas as a remedy for insects in mills and also that you desired to hear from anybody who used this receipt, I thought I would let you know the result of our test. After carefully reading your instructions and closely following them, we fumigated a 150-barrel mill with marked success. We allowed the gas to remain in the building a whole night and day, and the next morning after we entered we found that everything had perished, including many mice and weevil. The last day or so we have noticed one or two weevil, probably some that survived by being deeply buried in a crack. We can certainly speak a good word for the remedy, and thank you very much for your instructions, which has aided us in freeing our mill and warehouse from such a troublesome pest as a weevil."

Repeated applications teach us that the remedy is one that can be relied upon when properly used. An occasional miller, however, may get a bad lot of chemicals and can not generate the gas properly. One of my Canadian friends wrote me not long ago that he was not very successful in his fumigation, stating that the cyanide did not work in the acid and water. I was satisfied he had used an old grade of cyanide of about 58 per cent purity where he should have had the chemically pure cyanide, guaranteed 98 to 99 per cent. After some correspondence with the miller, I found my suspicions were well founded, and a few days later he tried the pure cyanide with good results. He wrote me as follows August 15:

"Your letter of July 22 was duly received and carefully noted. About ten days ago we fumigated again with the hydrocyanic-acid gas, and this time with complete success, hardly a bug or grub of any kind being left alive. We see an odd one occasionally, both moth and weevil, and we expect there will be some hatched out from eggs left, if so, we shall fumigate again in another month or so. The fumigation is so simply done, and so deadly, that we have now no fear but what we can keep our mill free in the future. We removed all flour, with exception of a few samples, but on these we could discover no taint. Our failure before was owing to inferior cyanide, just as you said, and was our chemist's fault entirely. We again thank you for your advice and information."

I personally conducted the fumigation of a five-story brick building in Baltimore September 18, 1900, infested with insects (*Lasioderma serricorne*), injuring leaf tobacco in store, and the method was thoroughly successful. I used in this building 50 pounds of cyanide at one time. The four upper stories were fumigated first, and a few days later the basement and first floors. We demonstrated that this gas can be used even in the heart of a solidly built-up city block if properly handled. The building in question is located in the heart of the business center of the city. Every crack about the windows was pasted up with narrow strips of paper. We used string and bags, suspending 3½ pounds of cyanide over each 4-gallon jar. We had six jars each on the second and third floors and two each on the fourth and fifth floors. The gas was generated after office hours at 7.30 and the windows were lowered from the outside about 12 o'clock midnight. The windows in the fifth story were lowered first, and by opening a door below a draft was created through the elevator shaft carrying the bulk of the gas out above the building. The other windows were opened a few minutes later and the building aired the rest of the night, one man remaining on guard all night. The results were very gratifying. The pests were thoroughly destroyed in the building. Seven dead rats were found on the basement floor and one on the third floor.

From recent results we are convinced that this gas is the most powerful and penetrating material ever used in a mill or other buildings for the destruction of vermin. It diffuses so readily that it will permeate all parts of a mill or inclosure in a few minutes. It is a deadly poison if inhaled by a human being, it is true, but there is no necessity of one breathing the fumes if the proper precautions are taken. I am satisfied that by the use of this gas many a miller can retain possession of his mill who would otherwise be obliged to give it up and acknowledge in the "struggle for existence" that it is the "survival of the fittest." It is humiliating, indeed, to be forced to concede that the flour moth or weevil is the fittest thing in existence, but some millers have actually been forced to abandon their mills on account of these insect foes. It is a satisfaction, therefore, that we can again give the experience of a very extensive milling firm who have saved their industry by the use of this gas.

November 28, 1899, I received the following letter from a well-known miller:

"We have read your letter, which is quite clear as to the method of making and using hydrocyanic-acid gas. In your estimating amounts you take a room 20 by 30 by 10 feet and work it out on that basis and advocate dividing the cyanide into packages

of about 16 ounces each. Our mill buildings are as follows: Main building, 34 by 78 by 14, five stories, and annex, 24 by 78 by 14, four stories. This figures out 290,472 cubic feet, and according to your article would require 159¾ pounds of cyanide, 240 of sulphuric acid, and 360 pounds of water. If this were put up in 16-ounce packages it would require 159 crocks to handle it, which at 15 cents each would be quite an item. Could we not use larger crocks and larger amounts of cyanide in each, thus reducing the number? What is the largest amount you would recommend to each package to obtain best results? We shall be greatly pleased to give you the result of our work in the application of this gas, with the hope that it will do the fraternity good."

In answer to the above I gave careful, minute details as to how the work should be done, stating that the cyanide could be put up in 5-pound packages, but that would necessitate a larger crock, the cost of which would be as much, if not more than the smaller ones.

December 30 I received the following letter: "We thank you for your letter of the 26th instant, with reference to the use of potassium cyanide. We are just getting ready to make the gas, and shall have much pleasure in acquainting you with the results. In discussing the making of the gas last evening, and taking into account our experience with bisulphid of carbon, we wired you the following telegram: 'Mill in valley, nearest house eight rods, on level top of mill. Is there any danger using this quantity? Reply promptly, collect.

"We found this morning that there is no telegraph office at College Park, and accordingly had message go via Washington and post. As we are anxious to get this fumigation finished and the mill in shape as soon after the new year as possible, we are in hopes of hearing from you to-day or on Monday.

"In regard to the bisulphid, we made a fair trial, but found it did not do what was necessary. We also found that, try as we could to make the mill tight, the odor was very distinct in the valley where the mill is situated. We did not report this experiment to you, as we did not wish to say anything about it. We will, however, make a report of the working of the cyanide for publication if our request as to our connection with it is left out, which we know you will readily grant."

I telegraphed the firm I did not consider there would be any danger, provided the wind was not in direction of house.

"We inclose a letter which we hope will be found readable as to our method of using hydrocyanic-acid gas. We are greatly indebted to you for your trouble in experimenting until you had found the proper proportion in which to use this drug in mills and also for your minute directions as to how it should be used with safety by millers. We feel that we can not express on paper the debt we owe you.

"As far as we can see to-day this gas has been a perfect success, and we do not expect to have any other report to make in the near future, as a long enough time has elapsed since we used the drugs to make the result certain. The reason that we did not write this letter before was because of a desire to see what a few weeks would bring forth—we believe we can now speak with certainty."

"February 27, 1900.

"Prof. W. G. Johnson,
"*State Entomologist, College Park, Md.*

"Dear Sir: In connection with our use of hydrocyanic-acid gas for the extermination of the Mediterranean flour moth, we beg to report the following: The cubic contents of our buildings figure 290,472 cubic feet, for which we used 151 pounds cyanide of potassium, 226 pounds sulphuric acid, and 338 pounds water. We distributed 150 crocks throughout the buildings, as directed by you, putting about an equal number on each floor, and into each crock we put 1½ pounds sulphuric acid and 2¼ pounds water. We then weighed out 151 pounds of cyanide and put this up in manila bags of 1 pound each; each bag was tied with a string upon which was left a loop. We placed screw hooks into different parts of the woodwork—spouts, elevator legs, etc.—passed through the hooks stout twine and so arranged that this twine would come directly over the center of each crock. Just where the string passed over the crock we tied an S hook, and on these hooks hung the bags of potassium.

"The stairways leading from the basement to the top of our mill go up at the side and nearly at the end of the building, one stair directly above the other. At the side and the ends of the mill farthest from the stairway we started six different lines of string, tying one end of each line to the opposite wall and leading each string to the stairway by a different route over the floor and tying each string tightly to the stairway rail, so that at the proper moment all the strings on the floor could be cut at the same time and all the little bags of cyanide would fall immediately into the solution without a miss.

"Each opening at the stairs had been provided with a tight door. The man who cut the strings started at the top floor, worked downward, cutting the strings on each floor as he passed through and closing the door behind him quickly as the strings were cut, so that it was impossible for even a whiff of the gas to reach him. [This gas being lighter than air, it was necessary to begin at top and work down.—W. G. J.]

"We cut these strings at 8 o'clock Saturday night and placed a man on guard all night. The odor of the gas was quite noticeable 12 feet away from the mill, although every precaution had been taken to close all the cracks by pasting strips of paper around the window sash and door frames, and otherwise making the mill as tight as possible. We opened the building at 9 o'clock Monday morning and could not detect more than the faintest odor of the gas. A careful examination showed the floor plentifully sprinkled with moths, flies, spiders, and occasionally a mouse or two. We examined carefully for the grubs or larvæ and found plenty of them dead, and but two or three alive in a mass of flour, but these were not by any means lively. We have watched carefully ever since—over two months—and have not seen but a very occasional moth since, and to-day, we believe, it is impossible to find a moth in our two buildings.

"We are delighted with the result of using this gas. In our case it has certainly been a decided success. We would say to anyone intending to use this gas they should take every precaution to have the manila bags of good quality, because the cyanide of potassium liquidizes after being placed in the bags and exposed to the air, and is apt to drop into the solution by the bag becoming wet and tearing at the bottom before the strings are ready to be cut. In conclusion, we wish to express our hearty appreciation of your painstaking care in the instructions of the use of this gas and also for your personal letters to us with regard to certain particulars we asked for.

"Yours, very truly."

[Name not published by request.]

This is, without doubt, the largest and most complete test of the gas ever made in an inclosure. I should have stated in the outset that, in figuring the amount of cyanide used, I estimated it on the basis of 0.25 gram per cubic foot of air space. I would not use a weaker strength in a mill or inclosure of any kind.

In discussing these papers S. A. Forbes, of Illinois, said that after a season's experience with fumigation with hydrocyanic-acid gas and some years' use of the insecticide sprays, both whale-oil soap and kerosene mixtures, he had come to the conclusion that none of these measures can be depended upon to exterminate the San José scale locally in actual field practice; that he had never promised to exterminate the scale anywhere or at any time, but had simply undertaken to do the best he could, and that recent inspections of infested premises treated a year ago by all the methods mentioned showed that not a single badly infested orchard had been completely cleared of the scale. In making hydrocyanic-acid gas he used one ounce of chemically pure cyanide of potassium and two fluid ounces of commercial sulphuric acid with an equal quantity of water, the above quantities being used for each 100 cubic feet of space. The kerosene mixtures used in his work approximated 20 per cent, most of them being applied in the form of a soap emulsion and diluted with a weak solution of whale-oil soap.

He thought that too much had been expected of our inspection system—more than any such system could possibly accomplish—but that the system is justified if it results, as he was sure it does and must, in a marked improvement in the condition of nursery stock and the practical suppression and exclusion of the more notorious nursery pests. He believed that anyone who had had even a very limited experience with inspection must have already seen an improvement in the general condition of nurseries, especially in the smaller and poorer ones having only a limited and largely local trade.

W. G. Johnson said the tent system was very unsatisfactory on large bearing trees. He said he was not surprised at the results in Illinois, judging from the account of the operations that had been furnished him by the assistant who did the work. He further stated that he had the same experience when he began fumigating, and soon found that minor details that had been overlooked, and not the gas, was responsible for poor results.

H. T. Fernald said that they had been quite successful using the gas in greenhouses at Amherst.

F. A. Sirrine, of New York, asked what length of time nursery stock should be exposed, to which Mr. Johnson replied that it depended on the kind and condition of the stock. June buds and low-grade peach, a light dose for a short time, while strongly dormant, well-matured peach and other fruit trees would stand the normal dose for a half to one hour or longer.

The next paper, by G. B. King, of Massachusetts, was read by the secretary, as follows:

The Danger to American Horticulture from the Introduction of Injurious Scale Insects.

It must be admitted that the greater part of our injurious insects have been introduced from abroad, and the object of this paper is to show some of the more recently discovered scale insects which have been introduced into Massachusetts. Although our list of scale insects is larger than that of any other State or Territory in this country, it should be understood that a very small portion of it has been worked up. Therefore, when we go into a new locality we are always sure to find some new insect hitherto not known to inhabit this State, or find some of the already described species from abroad previously not known to inhabit the United States, and very often infesting plants different from those from which they were originally described.

Take, for an example, our native species *Chionaspis furfurus* Fitch, described from apple, is now known from 23 different food plants. I have it from 15 in Massachusetts alone. Again, take its congenial running mate, the imported apple-bark louse *Mytilaspis ulmi* L., syn. *M. pomorum* Bouché, originally described from elm in Europe, is now known from 47 different food plants throughout the world. I have examples of this on 23 food plants found in Massachusetts. It is therefore hard to predict how a species of recent introduction or newly discovered species are going to act in a new country or locality.

In many cases, however, we do know that they have become very serious pests to us, while in their native homes they were comparatively harmless.

In my first paper, entitled "Contributions to the knowledge of the Coccidæ of Massachusetts," a list of 13 species was given as recorded up to January, 1896. Five of these were native, while 8 were introduced. In my fourth paper, bringing all the known species together up to August, 1899, we had 79 species and varieties. Of these, 44 were native and 35 introduced species. Since then, just one year, we have found 31 more, 17 of which have been known from other States and 10 introduced species, and some of the latter were new to North America. Adding these to our previously published list, makes 110 species of Coccidæ found in Massachusetts,[1] with several more awaiting study.

The following are some of the more recently discovered species, all found at the Harvard Botanical Gardens, at Cambridge, Mass.: *Lecanium oleæ* Bern., the well-known black scale of California. This was found on a small shrub. I believe this the most northern locality in which it has been known to live out of doors. Another species, very closely allied to "*oleæ*," was found in the greenhouse on *Cycas revoluta* (not included in the above list). *Aspidiotus rapax* Comst. was found on *Coprosma baueriana; Hermichionaspis aspidistrae* Sign. on a fern (*Davallia moorsona*); *Diaspis minima* Targ., on *Thuja orientalis* from China; this is new to North America. *Dactylopius nipæ* Mask., new to America, on an unknown plant in the tropical greenhouse. On the same plant was also found *Aspidiotus* sp., new to Massachusetts, now in the hands of Professor Cockerell. *Lecanium tessellatum* Sign. was found plentifully upon 15 different greenhouse plants, most of which were set out of doors for the summer months.

Lecanium fletcheri Ckll. (a North American species) was found on *Thuja occidentalis* var. This species was described from Ottawa, Canada, in 1893. Last spring I received some scales from Vienna, labeled n. sp. These I have examined just lately, and they are identical with the *L. fletcheri* received from Dr. Fletcher.

Aspidiotus brittanicus Newst. I have found in abundance on holly at the Boston Public Gardens. This was described from England in 1898. April of the same year it was found at Salem, Oreg., and this year, July 15, I found it at Boston, Mass. It has been identified by Professor Cockerell and Mr. Marlatt.

While writing this paper I received a visit from the agent of one of the largest

[1] This list at present, March 25, 1901, contains 115 species.

woolen manufacturing corporations in this country. He brought to me for identification a lot of larvæ, which proves to be the larvæ of *Attagenus piceus*. It seems that a large lot of imported wool was first noticed infested, and the larvæ were found plentifully in the packing room of the corporation, where there are thousands of yards of finished goods.

Therefore, in view of such facts as I have cited, what should be done to prevent the wholesale introduction of injurious insects within our borders? In the writer's opinion there appears to be but one way out of it, and that is to establish a quarantine system under the immediate direction of an entomologist. Furthermore, with the addition of our new Territories and rapid means of transit, together with a large addition to our American merchant-marine vessels under construction (10, I think, aggregating 81,600 tons), it seems that the time has come when we should have some means whereby we can ascertain whether the trees, plants, and fruits coming into our ports are infested or not.

The entomologist in charge should have authority and means at hand to prevent their introduction. As before stated, a very small portion of Massachusetts has been searched for "Coccidæ," and much credit is due Professor Cockerell, who first advised me to take up the study. Had it not been for him our knowledge of the number of these insects inhabiting this State would still be as limited as it is of most of the others, of which very little is yet known.

The second session of the section was held at Wesleyan University, Middletown, Conn., November 14, at 2.30 p. m., with fifteen members present, Chairman Garman presiding.

A paper was read by S. A. Forbes, of Illinois, as follows:

Nursery Inspection and Orchard Insecticide Work in Illinois.

The main purposes of the Illinois horticultural inspection act are two: (1) To prevent the further dissemination in that State, through the nursery trade, of dangerous insects and fungus pests of fruits; and (2) to prevent the injury, by insects and plant diseases, of the horticultural property of one citizen as a consequence of the ignorance, negligence, or indifference of another. For the first of these purposes a system of nursery inspection is established, with the State entomologist as the general and responsible inspector, his certificate of the substantial freedom of nursery property and premises from dangerous insects and contagious diseases of plants having the force of a legal license, valid for one year, without which license no sales of such property can lawfully be made. To prevent the introduction of diseased or infested nursery stock into the State, transportation agencies are forbidden to deliver any consignment of uncertified stock originating outside the State.

For the second purpose, it is made the duty of the entomologist to inspect orchards and other similar property whenever there is reason to suppose them to be affected by dangerous insects or contagious plant disease, and power is given the inspector to place such quarantine restrictions upon this property as may be necessary to prevent the extension of the injury to the property of others. If, after due notice, prescribed measures of insecticide treatment or disinfection are not taken by the owner, the entomologist is required by law to take them himself, half the expense of the operation being borne by the owner and the other half by the State. Orchards which became infested by the San José scale previous to 1899 are excepted from this last provision, such orchards being once treated by the entomologist without charge to the owner.

I have been somewhat embarrassed to determine just what should be called a nursery under the law, the dictionary definitions of the work being usually very comprehensive and sometimes indefinite. By the Standard Dictionary a nursery is defined as "a place where trees, shrubs, flowering plants, etc., are raised for sale or transplanting," and by the Century Dictionary as "a place where trees are raised, from seeds or otherwise, in order to be transplanted; a place where vegetables, flowering plants, and trees are raised (as by budding or grafting) with a view to sale." Both these definitions might easily be made to include plantations of small fruits, greenhouses, truck gardens, and gardens of flowering plants. Being strongly of the opinion, however, that it was not the intention of the law that property of this kind should be subject to the annual inspection, I decided to apply the term in the sense in which it is commonly used in business; that is, to make a distinction between the nurseryman, the florist, and the vegetable gardener, while recognizing the fact, of course, that some nurserymen sell flowering plants and some florists sell nursery stock. In this sense a nursery may be defined as a place where trees, shrubs, and woody vines are grown for sale.

As a result of our first inspection, it appeared that there were 245 active commercial nurseries in the State.

Two forms of certificate were used, one certifying that "the growing nursery stock and premises" of the owners had been inspected, etc., and the other that the nursery stock, "bearing this certificate and grown on the premises of ——— ———," had been inspected. It was an especial advantage of the latter form of certificate that I could limit its application to special kinds of nursery stock or exclude from its scope kinds and conditions to which serious exceptions were taken. For example, using this form of certificate I was able to say that it did not apply to trees injuriously infested by the woolly aphis or affected in any degree with the root or crown gall, and as the use of my certificate for stock to which it is not applicable is under the Illinois law a misdemeanor punishable by fine, the appearance of the certificate on so much as a single tree showing the crown gall would be prima facie evidence of the violation of the law.

It is a requirement of our inspection act that all expenses of nursery inspection shall be paid by the owners of the nurseries, and that the certificate shall not issue until such payment is made. As the law does not prescribe any method of distributing costs of inspection trips to individuals whose premises are inspected, I was obliged to assess these expenses according to my best judgment of what was fair and just to all concerned; and as the trips of my inspectors were not made separately for the purpose of inspecting individual nurseries, but were general trips in the course of which a large number were visited in succession, I was obliged to adopt some plan of division of the total expense of this common trip. After careful study of the workings of various possible plans the following method was adopted: The inspection reports and bills of expense of each inspector were brought together every two weeks, and the total cost of inspection for this period, including the salary of the inspector, was distributed among the nurseries concerned in such a manner that all should share equally the cost of transportation and some other general expenses, while the cost of subsistence and the pay of the inspector were divided among them in proportion to the time required for the inspection of each nursery. Thus, if 20 nurseries were examined in these two weeks, each was charged with a twentieth part of the mere expense of traveling; and if the time spent in the inspection of a given nursery was, say, a fortieth of that spent in the inspection of all of them; then it was further charged with a fortieth of the salary and the cost of subsistence for the two-weeks' period. In this way such expenses as had no relation to the size and condition of the nursery were divided equally; such as had some such relation were divided proportionally; and the total cost of all the trips was fully and exactly provided for.

This scheme worked, on the whole, fairly and well, but had one minor disadvantage in the fact that it was practically impossible to make itemized statements to individual nurserymen, since the items would have included a complete exhibit of two weeks' expense of travel, but few of which it would have been possible for the individual nurseryman in any way to verify. Bills were consequently rendered for the total sum due for each inspection, an explanation of the method of its determination being also sent if any questions were raised, and the account was certified by me officially, as required by law. It must be admitted, however, that this method of assessment is liable to abuse, since, under a careless or unscrupulous officer, it would be impracticable to detect errors or overcharges except by a systematic investigation, which the law does not itself provide for. Either these inspection accounts should be subject to audit and approval before they are sent out to nurserymen or the method of the Ohio law should be adopted, making a minimum charge for the certificate, with additions according to the time required for the inspection.

The cost of the first year's inspection averaged $5.77 per nursery for pay of inspector's time and traveling and incidental expenses. No charges were made against nurserymen for printing, general supervision, or clerical and other office expenses. The cost of inspection was considerably reduced the second year, amounting only to $3.74 per nursery, this reduction being due wholly to the greater rapidity with which the work could be done with the benefit of a year's experience and with reports of previous inspections in hand.

An examination of the inspectors' reports with regard to the occurrence in Illinois nurseries of dangerous insects and contagious diseases, the distribution of which it was the main intention of the law to prevent, discloses some interesting and important facts.

The woolly aphis was reported this year as occurring in noticeable numbers upon the apple in 61 of the 245 nurseries, the ratio of infested trees in the various lots ranging from 1 to 90 per cent. This ratio was estimated at less than 5 per cent in 15 of these blocks, at 5 per cent in 24, at from 6 to 10 per cent in 15, at from 11 to 25 per cent in 4, and at 30 to 90 per cent in 8.

The root rot of the apple was detected in only 8 nurseries, and in all but one in only insignificant quantity.

The peach-tree borer was reported in either peach or plum, or both, from 37 nurseries, and in ratios varying from 2 to 95 per cent of the trees subject to its attack.

The contagious and destructive but comparatively little-known disease now commonly called crown gall was reported from 52 nurseries—more than 20 per cent of the whole—as affecting from 1 to 100 per cent of certain blocks of apple stock. In 14 of these nurseries less than 5 per cent of the trees in these plats were so diseased, in 15 of them from 5 to 10 per cent, in 16 from 15 to 25 per cent, in 8 from 40 to 75 per cent, and in 3 from 90 to 100 per cent.

In all cases where the crown gall has been found in more than purely insignificant ratio the inspection certificate has been withheld until the owner of the nursery has agreed in writing to destroy all the trees so diseased. Similar conditions were made with regard to nurseries containing trees infested by the peach borer, and those in which more than 5 per cent of the trees in any block or lot were shown to be seriously infested by the woolly aphis. In all such cases the certificate, when finally issued, has been so limited in writing as to make unlawful its use for trees affected by these insects or this disease.

The detection of the San José scale in one Illinois nursery in 1897 and its subsequent extermination there were reported in Bulletin 56 of the Agricultural Experiment Station, published in July, 1899. As a result of the inspections of the past two years this insect has now been found in five other nurseries, or in six if we include in the number a lot of trees belonging to a dealer which had been left over from the sales of previous years and set out in nursery rows. One of these nurseries, occupying two city blocks, was badly infested with the scale in one part of its area, but in all other cases the presence of the insect was detected by us while its numbers were very small and before it had spread in the nursery to any harmful extent. Evidence of the former distribution of the scale to customers has been found in connection with only two of these nurseries—on a few lots of fruit stock from one of them and on single shade trees set out on city premises from the other.

In all these nurseries I have required the thorough destruction of everything known to be infested, with the single exception of a block of ornamental trees in one nursery, which have been held out of the market and treated, as an experiment, by the repeated application of insecticide sprays. Furthermore, all stock in each infested nursery has been quarantined, and no sales have been permitted until after a thorough fumigation with hydrocyanic-acid gas under the direction of an assistant detailed for the purpose; and if there was reason to suppose that any part of the nursery might have become obscurely infested, such suspicious stock has been wholly withdrawn from the market until its condition should declare itself to the satisfaction of an inspector. It thus seems perfectly certain that no infested stock has gone out from these nurseries under the office certificate. No San José scale can now be found in any Illinois nursery, with the exception of a small lot of stock in Sangamon County remote from any similar property. The owner is also an orchardist, and his entire premises are under strict prohibitive quarantine.

The principal original purpose of the Illinois law was the detection of the San José scale in orchards infested by it and the prevention of its further introduction and distribution by way of trade. A systematic inspection of all the orchards of the State was entirely impracticable, but every means of securing indirect information was utilized from the time of the first discovery of the scale in the State in September, 1896. Much special travel was also made by office inspectors to points which I had reason to believe had become infested. As an outcome of these various methods of inquiry the San José scale has been found in 44 different localities, 5 of which are in the northern, 19 in the central, and 20 in the southern section of the State. Its distribution in some localities has not been fully delimited, but it is known by us to occur on 243 farm premises and on many town lots in 9 villages. At 10 of the 44 points infested it has been definitely exterminated, leaving 34 at which we know it still to occur.

Our treatment of infested orchards began October 15, 1899, with the fumigation method, and continued with that method for two months, by which time it was evident that it was altogether too slow and expensive, as applied to trees of all varieties and ages in the orchards of southern Illinois, to enable us to use our limited appropriations to the best advantage. During the remainder of the season our principal dependence was upon insecticide sprays, first of whale-oil soap and later of the kerosene emulsion. Recent inspection of the trees thus treated shows that none of these methods can be regarded as efficient for the extermination of the scale, although single trees here and there had apparently been cleared. In occasional instances fumigation had evidently failed as a consequence of unfavorable weather

conditions. The oiled canvas was not wholly impermeable, and when high winds were blowing the charge of gas was evidently diluted by fresh air coming through the cloth. Indeed, a strong smell of the gas could always be perceived on the leeward side of the tent under these conditions. In very cold weather the moisture from the evaporating fluids used in the liberation of the gas condensed on the cloth and froze, so stiffening the tents that they could be handled only with great difficulty and were easily torn or broken with the breaking of their icy lining. The frequency with which the lower part of the trunk of an infested tree was found well covered with living scales while nearly all higher up were killed by the gas leads me to suppose that the gas is likely to rise from the ground, concentrating in the upper part of the tent, and leaving the air in the lower part of the inclosure insufficiently charged with the poison.

Many trees in the region most extensively infested were altogether too large to treat successfully by any insecticide method. No tents could cover them, and no spraying operation could be expected to reach all parts of the surface. It was a special disadvantage of insecticide sprays that as a rule the fruit buds of peach trees were killed by them, whether whale-oil soap or kerosene was used. As the spray does not kill all the scales, it must be repeated at occasional intervals, and if each application has the effect to destroy the crop of the following year the outcome will be decidedly discouraging to peach culture in the infested region. It is much to be hoped that an insecticide method may be devised, neither too expensive nor too cumbersome for use by the ordinary horticulturist, which will destroy the San José scale without injury to peach buds. In consequence of our experience, and desiring to use the remainder of the funds available for this work to the very best advantage, my assistants now in the field are depending almost wholly upon a mixture of 20 per cent of kerosene with water, applied by means of a mechanical-mixture pump.

An indirect result of our inspection operations was the discovery of the peach yellows in southern Illinois, in and about Duquoin, in Perry County, a locality where it seems to have been established for eight or ten years. It has been detected in some twenty orchards, distributed over an area 15 miles long by 14 wide.

The general results of the operation of the Illinois law may be briefly summarized as follows:

As a consequence of the annual inspection of nursery stock, followed as it has been by critical observations from this office in all cases requiring them, a rapid improvement in the condition of Illinois nurseries is manifest, especially in those parts of the State where the same region was covered both years by the same inspector. Insects found too generally prevalent on the first inspection have largely disappeared from nurseries, old and worthless stock has been cleared out and destroyed, and evidences of greater care in management are generally noticeable.

The detection of the San José scale in six of these nurseries and its complete destruction there before it had been disseminated to any serious extent, and the discovery of the crown gall as an important nursery pest much too prevalent in many comparatively small and neglected nurseries, are also notable benefits resulting from this inspection. Furthermore, the accumulation of a very large amount of information with regard to the common insects of the nurseries, those injurious to the property of the nurseryman rather than to that of his customer, will enable me to prepare a particularly valuable article on the subject of nursery pests.

The supervision of importations of nursery stock which the law has required has undoubtedly prevented in great measure the introduction into the State of worthless and infested trees. As long as Illinois had no such law it was certain to be the dumping ground of unprincipled dealers anxious to free themselves of dangerous or suspicious property which they were unable to sell in States protected by restrictive legislation. It should further be noticed that a law of this kind has now become practically necessary to the nurseryman if he does business outside of his own State, since without inspection and an official certificate thereof his products are excluded from most of the best markets of the country.

Our inspection of orchards with reference to the San José scale has resulted in an early discovery of this insect in many localities where it would otherwise have remained unnoticed until it had spread extensively and done great and irremediable harm. Although the places are but few in which the scale has been completely obliterated by our insecticide work, yet it has been brought under the control of the owners of infested premises in a large number of such places, and fruit growers in several counties have been fully informed, both by instruction and by demonstration in the field, with respect to the methods of procedure necessary to protect their property henceforth. Much valuable practical information has also been obtained in the course of our extensive field operations with respect to practicable and economic methods of procedure and the objects we may hope to accomplish in a contest with

this insect. Fortunately it appears that the simplest and cheapest methods with insecticides most easily obtained are as effective in practical work as those most expensive in equipment, labor, and material.

J. B. Smith, of New Jersey, then read the following paper:

NOTES ON CRUDE PETROLEUM AND ITS EFFECTS UPON PLANTS AND INSECTS.

Contrary to the testimony that has been given by a number of others, crude petroleum has never in my hands injured a single tree of any kind to any notable extent. In saying this I do not mean in any way to discredit what others have said; simply to call attention to the fact that there may have been differences in circumstances, or in the material used, that have contributed to the good or the bad result, as the case may be.

The material used by me has had a specific gravity of 43° on the Beaumé oil scale, and I have used this undiluted and liberally at all seasons of the year. I do not recommend it for summer applications, and have so written. If used when the trees are dormant, and in any reasonable way, I do not think that it will harm trees of any kind. I have never succeeded in killing a tree by its use. I have succeeded in killing fruit buds on peach, and to some extent on pear, where I set out with the deliberate intention of doing this. On one peach tree I painted every bud individually, and killed all but one; but I did not harm even a single leaf bud, and at the end of the season the tree is in as good apparent condition as any others on the place, with a heavy set of fruit buds for next year. The best I could do on a Japan Golden Russet pear tree was to kill about 50 per cent of the buds by painting. In spraying a peach tree I have succeeded in killing a percentage of the buds, leaving enough remaining for a crop. I have sprayed at all times, from the tree hardly dormant to when buds were opening. I sprayed a peach tree when the blossoms were just opening. Very little fruit set upon this tree and the blossoms were apparently infertile. Whether this was due to the effect of the oil or to the fact that bees did not visit the oily tree I am unfortunately unable to say. I did not realize early enough the importance of the point and did not watch closely enough. It is certain that, whereas the flowers of a neighboring tree, which had been untreated were full of bees, none were seen on the tree which had been sprayed. I assumed that the odor of the oil kept them off. It may be, however, that the oil destroyed the essential organs of the flower and thus killed it.

What is nominally known as crude oil has killed trees in New Jersey in some cases; but so far as investigated the oil has always been found to be much heavier than that employed by me. The practical result is that an oil fit for insecticide purposes, if to be used undiluted, must have a specific gravity of at least 43°. This is for oils having a paraffin base. Injury that is caused by oil seems, as nearly as I can make out, to be due to the penetration of the vaseline. Roughly speaking, we have in crude petroleum the lighter and heavier naphthas, a heavy wax or paraffin, and a lighter greasy substance or vaseline. The paraffin does not penetrate and remains in the form of a coating on the outside of a tree. The lighter naphthas penetrate all dry absorbent material almost at once and then disappear. The heavier naphthas follow soon after, leaving the vaseline and paraffin. Vaseline never dries up. It thins a little under heat and it will penetrate any dry substance and keep on penetrating until it is entirely absorbed. The paraffin hinders this penetration to some extent and holds the vaseline. If an excess of vaseline lodges on or behind a bud it will penetrate into the plant tissue and keep on until it is all absorbed. It is in that way that injury is caused. A heavy oil is one that contains an excess of vaseline or paraffin. If it is paraffin it does not matter so much. If it is vaseline the oil becomes dangerous. Some oils that have been used were said to be crude, with the wax out. This means that the paraffin had been taken away, leaving the vaseline, and the results were fatal in most instances. I have used such an oil having a specific gravity of 35° and killed peach and cherry where it was applied. I think if we realize the manner in which the oil acts we can use it safely, and it is certainly the most effective material that has ever been applied as against this pernicious scale.

C. W. Woodworth said they had apparently all grades of oil in California and got all kinds of results.

J. B. Smith said California oils would have to be tested on their own merit.

S. A. Forbes called attention to injury to trees by insects after oil had been used, referring particularly to the attacks of *Scolytus rugulosus*.

W. G. Johnson stated the same injury had been seen in Maryland, especially on peach trees. In some cases where a single limb on a tree had been killed by a blast

of oil the fruit bark beetle invariably attacked it. This was considered a natural result, as *S. rugulosus* does not as a rule attack a perfectly healthy and normal tree. If a tree is injured from any cause whatsoever, this insect usually attacks it.

Mr. Woodworth asked if any definite work had been done on the effect of the oil on protoplasm and cell tissues.

Mr. Smith said vaseline would penetrate the wood and cells if there was the least rupture of the bark.

F. A. Sirrine, of New York, read the two following papers:

A Little-Known Asparagus Pest.

Agromyza simplex Loew

During the fall of 1896, while examining asparagus fields for asparagus rust, Mr. F. C. Stewart and myself found puparia beneath the bark of many of the asparagus stems. These puparia were usually found in the portion of the stem which was below the surface of the ground. When they occurred in portions above the surface, they were always near enough to the ground to remain moist and not dry out with the drying of the stems.

An attempt to rear the adults was made at the time the puparia were found, but the stems were allowed to become dry, and no adults were obtained. By collecting the old stems in early spring I have since succeeded in rearing the adult fly. This has been determined for me by Mr. Coquillett as *Agromyza simplex*.

As far as life history has been traced, the adult flies issue from puparia about June 1. A fairly distinct second brood occurs in August, after which adult flies, maggots, and puparia can be found until late in October. Later, only puparia are found. Although not definitely proven by field observations, it would appear that not all the puparia of the first brood issue as adults the same season, many apparently remaining dormant until the following spring. The eggs have not been found, but the mines which the larvæ make indicate that they are generally deposited behind the leaf bracts of the plants.

It is impossible to estimate the amount of damage done by this pest. It is doubtful if it ever does damage enough to be of much importance economically.

A Power Sprayer for Asparagus.

One of the principal disadvantages in the spraying of asparagus is the difficulty of treating such a plant, combined with the lack of suitable machinery for doing the work on a large scale. This, together with the results from spraying which some have obtained, has all led to the general conclusion that but little can be done along this line toward checking the ravages of the asparagus rust.

In our work on asparagus rust on Long Island it was found impossible to do the work thoroughly by hand machinery. The lack of thoroughness did not result from carelessness on the part of workmen, but from the impossibility of reaching all parts of a heavy growth of asparagus by hand machinery. Some parts would be drenched until the liquid would not adhere to the smooth foliage, while other parts of the plant would not be reached at all. Furthermore, the materials and time required to do the work with hand machinery made the spraying of asparagus expensive. It was decided to attempt the building of a machine which would not only do the work more thoroughly than could be done by hand, but also more expeditiously. The work which had been done by hand machinery convinced us that it would be necessary to construct a machine to carry 250 to 300 gallons of liquid in order to save time and make any headway. With these facts in view a machine was constructed without reference to unwieldiness or cost. The result was the construction of a power machine with arched axles to straddle one row without injury to the asparagus, carrying 250 gallons of liquid and spraying two rows at a time. It is fitted with not only an adjustable nozzle carrier, carrying twenty-four nozzles, but also an adjustable lifter or rake for handling the asparagus.

The carrier is made so that it can be adjusted to spray rows set from 4 to 7 feet apart. The carrier has four arms hung at the center so they can be swung with a shear motion. Each arm also has two telescoping joints, hence are adjustable for varying heights and widths of rows. Each arm carries four nozzles—two at each end. Each nozzle is connected to the arm by means of a ground union and a short elbow. This not only allows of the nozzle being set at any angle, but also allows it to turn when caught instead of breaking or bending the arm. Only two styles of joints are used in the carrier—namely, telescoping and union joints. These are so

combined that they form a universal joint. The carrier and lifters are not only adjustable, but are also provided with brakes for lifting them above the asparagus when desirable.

A triplex pump, making 50 revolutions per minute, is used to supply the carrier with liquid and give the required pressure. As constructed, the pump was geared back 1 to 5. The gearing was removed and a small sprocket wheel attached directly to the crank shaft. The latter connects indirectly, by means of chains and other sprocket wheels, to a sprocket attached to the left rear wheel.

Standard sizes of connections and piping were used not only in the carrier, but also in connecting pump to tank and to carrier.

In the absence of the author, the chair asked the secretary to read the following paper prepared by H. A. Gossard, of Florida:

Economic Entomology in Florida.

While not all college and station entomologists would freely choose to add the often perplexing duties of inspection to their regular work, it seems to be the accepted judgment of the public, as well as of the entomological fraternity, that by so doing they render a valuable public service, and certain it is that they are practically compelled to assume such duties if they are to keep their hold upon their constituencies. An inspector acting voluntarily, as in Florida, enjoys larger freedom of action in some respects than would be the case if he were charged with the execution of a special law prescribing set rules and regulations, while from another point of view his individual responsibilities are at the same time greatly increased, since he must exercise prerogatives legislative, judicial, and executive, without having the backing of a legislature or horticultural board. He may prescribe the conditions upon which he will issue a certificate, but except as he is able to force compliance with his conditions because of the volume and value of the certified business done by the respective nurseries, or because of the fear of publicity that he might give to dangerous stock, he is powerless to compel the destruction of pests either upon or adjacent to the nurseryman's premises. No difficulty is likely to follow the finding of pests upon the premises of a nurseryman who has requested an inspection, since he will almost invariably understand his interests sufficiently well to wish their extermination even more heartily than the inspector; but when his stock is menaced from outside sources the problem is not always easy, though it may sometimes be met by his inducing the owners of infested material to destroy it by offering to furnish them healthy goods at greatly reduced prices or as a donation. A small nursery with much infested material in its neighborhood might find the cost of putting itself into reasonably safe condition a very burdensome outlay.

No certificates are issued to Florida growers of either nursery or greenhouse stock without their having approved fumigatoriums or greenhouses so constructed that they may be rendered practically gastight, and in all suspicious localities all stock of every description sold, shipped, or transferred must be carefully fumigated before it leaves the nursery grounds. All certified nurserymen are required to fumigate all untreated stock received by them before setting it out, and careful attention is given to the clearing off of all blocks of stock that have been in the ground for more than two years.

As an illustration of the value of inspection work, I may cite an instance in which one of our Florida nurserymen requested an inspection after having permitted two years to pass since his last examination. After inquiring as to where he purchased his budwood, and knowing it to be from a suspicious source, I scrutinized it closely, finding two among about twenty peach trees closely planted in nursery row with interlacing branches, and all having been used for budding purposes earlier in the season, infested with San José scale, though so sparsely that I would almost certainly have overlooked it if my previous knowledge of the nursery from which it came about nine months earlier had not impelled me to give the minutest attention to the examination. The entire lot of budwood with other stock immediately adjacent to it and all stock budded from the two infested trees was at once dug up and burned, apparently resulting in the perfect extermination of the pest in its incipiency, since no indication of it could be found at my last visit, one year after the discovery. The owner of this nursery believes in annual inspections.

As an illustration of my statement that the voluntary inspector is sometimes obliged to face unpleasant responsibilities, the following question seems certain to face the Florida entomologist sooner or later: "Shall a certificate be issued to a nurseryman having white fly either upon his premises or in his neighborhood?" White fly, *Aleyrodes citri*, one of the worst and at the same time one of the most uncontrollable

pests known in Florida, is gradually extending its distribution throughout the citrus belt. It has long been on the west coast, in south and central Florida, and is now reliably reported to be established on the east coast, though I have not received specimens from there. It occurred at one time at several points in the northern part of the State, but retreated southward with the oranges and is scarcely, if at all, observed in its old haunts in the upper portion of Florida.

A number of nurseries are located in southern Florida, and it seems certain that if white fly is not now present in them, that it must eventually reach them all. Under present conditions certificates are issued to Florida nurserymen for the primary purpose of enabling them to meet the requirements of other States, and since, with the exceptions of Louisiana and California, none of the other States grow citrus plants to any extent, it may be doubted if white fly would be a serious economic insect in their territories or if, indeed, it could live in them at all; and, futhermore, since the Florida lawmakers have practically said through their past three sessions that quarantine work is considered neither necessary nor desirable, it may be somewhat of a question as to whether a certificate should or should not be issued to nurserymen in white-fly neighborhoods, the insects not being listed outside of the State as pests, though there can be no doubt that they would be considered unquestionable pests in all citrus-growing districts. If they are not objected to outside of Florida, a nurseryman might feel that the entomologist was assuming an unwarranted legislative prerogative in refusing to give him a certificate upon grounds considered insufficient to warrant action on the part of the State legislature, and at the same time a very intelligent contingent of the Florida public might have serious objections to a certificate being issued to him under such circumstances. To furnish a certificate that might be used outside of the State, but forbidden for use in the State, would be one way out of the difficulty, yet, in many respects, an undesirable way, tending to add to the confusion that already exists from lack of uniform practices in granting certificates.

It may be further observed that it is not clear that repressive measures would greatly retard its spread in any districts below the line of severe frost. The adults of both sexes being winged, buggy tops, railway coaches, and various other means of carriage serve to distribute them, perhaps even more rapidly than scales are scattered. Nursery stock with infested leaves, after being defoliated and fumigated, might be reasonably safe, but I am not sure that it would be so. A gentleman, who to my personal knowledge is acquainted with and able to recognize white fly, related to me that he once ordered some orange or grape-fruit buds from southern Florida and found the interstices between the bud scales filled with white fly pupæ, thus contradicting a prevalent opinion that the insects occur only on the leaves. If this observation was correct, as I believe it to have been, it will require some experimentation to determine whether hydrocyanic-acid gas, used at the maximum strength that buds are able to stand without injury, is fatal to such sheltered pupæ.

If correct repressive practices can be devised, suited to the characteristics of the respective species, it would seem that four insects occurring in Florida are of enough importance to be recognized by law as pests, viz: San José scale, *Aspidiotus perniciosus;* West Indian scale, *Diaspis amygdali;* cottony cushion scale, *Icerya purchasi;* white fly, *Aleyrodes citri;* to which *Aspidiotus juglans regia* and *Aspidiotus forbesi* may, perhaps, be added. Of these, white fly is probably the most important and most uncontrollable, with San José scale and West Indian scale close seconds.

SOME ICERYA HISTORY.

This pest seems to have found its way into Florida through a curious accident. In 1893 a firm of nurserymen at Keene, Fla., addressed an inquiry to some parties in California inquiring about the merits of the ladybug, *Novius cardinalis*, and as to the possibilities of its proving useful against some of our common Florida scales. These nurserymen affirm that they did not request that any ladybugs be sent, but merely inquired about them. However, their correspondent packed up a number of ladybugs and also inclosed some of the scale for the purpose of supplying food for the ladybugs on their journey. The firm say further that they were not notified that the scale had been inclosed, and having no knowledge of the fact that the ladybugs would feed upon no other material than this scale, were entirely unsuspicious of danger; so, after turning the ladybugs loose, they innocently left the box in which the ladybugs were received in the neighborhood of one of their grape-fruit trees, and as a consequence they found this and some of the adjacent trees infested with the scale a few months later. When specimens of the scale were sent by the firm to the United States Department of Agriculture for identification, Mr. H. G. Hubbard was sent to Keene to investigate and advise with the owners of the infested grove. The infested trees were cut down and burned and all suspicious

stock was treated in the same manner. However, the scale was present in large numbers a few months later, and Professor Rolfs, then of the Florida Station, paid a visit to the locality and repeated the processes of burning and destruction. All ground on which the insect was suspected to be present was covered with straw, chips, and litter, the whole treated liberally with kerosene, and set on fire. Nothing further was heard of the scale in Florida until November 1898, when Dr. Howard was informed that it was again in evidence at Clearwater Harbor, about 2 miles from the place where it originally appeared. Mr. Hubbard, residing at Crescent City, Fla., received similar information. These letters were referred to the Florida Station, and an investigation of the infested district was made by the writer. I heard a statement to the effect that a dealer in nursery stock had brought some California stuff to Clearwater sometime about 1895, and had heeled it in in the grove which was found to be most badly infested, and this possibly may account for the outbreak of Icerya without reference to the introduction first mentioned, though we are inclined to think from the surroundings that it has been present since 1893. The insect spreads with considerable rapidity, and during the summer of 1899 extended its distribution from the original 20 to 30 acres to which it seemed to be confined at the time of my first examination, until it included groves 6 or 7 miles from town. It was greatly reduced in numbers during July, August, and September by a fungus disease and native predaceous insects, only a few remaining by winter time. It commenced to replenish in December and reached a maximum again in June, 1900, at this time seriously threatening the life of some groves, and having extended its distribution so as to include one-third or possibly half of the groves within a radius of 6 or 7 miles from Clearwater.

An attempt was made to colonize the Novius during the summer of 1899, but it was apparently unsuccessful. Somewhere between two dozen and thirty insects were hatched from California shipments and kept under observation until they were observed to have copulated, when they were confined upon limbs, thickly infested with Icerya, in large canvas sacks for from twelve to twenty-four hours to insure the deposition of their eggs, after which the sacks were removed and the beetles were given the freedom of the grove. Within two or three weeks from the time the insects were loosed a fungus disease, determined by Mr. Ernest Bessey to belong in the family Phymatasporæ, struck the scales, and immediately following a flood of rain on the 12th of July I estimated that fully 95 per cent of them had perished during the preceding seventy-two hours; probably not one scale out of 1,000 was living upon these trees three weeks later, and like conditions prevailed, though in less degree, over the entire grove. Whatever ladybug larvæ may have been present in the grove must have perished with the scale, at least no ladybugs ever made their appearance.

One of the residents of Clearwater succeeded in getting a consignment from the county board of horticulture at San Diego, Cal., about the middle of April, and the bugs were turned loose upon an infested tree in accordance with the instructions received along with the insects. While no explanation for their failure to propagate can be given, no subsequent trace of them could ever be found. It is possible that they were not wasted, but that their progeny became mixed with that of later importations of bugs colonized at no great distance from them, though we have no evidence to suggest such a probability. Three colonies of the insects were sent to Clearwater by Mr. Craw, of the California State board of horticulture, under date of May 28, 1900. One of them was sent to Mr. Thomson at my request, the other two being sent to Mr. Markley, by request of his brother, who resides in California. Mr. Thomson was instructed to have an infested tree tented with cheese cloth for the reception of the insects upon their arrival, as previous experience in putting bugs upon unenclosed trees had failed to give satisfactory results. Mr. Markley, after conferring with Mr. Thomson, adopted the same plan, using canvas instead of cheese cloth. One of his colonies was placed upon a tree standing in his yard in Clearwater, and the other was sent to the grove of Mr. William McMullen, about 7 miles from town. The rainy season sets in at about this time, and fearing another onslaught of fungus, we wrote to Mr. Thomson about ten days after his receiving the insects, giving him instructions to remove the tent and give them the freedom of the grove. This suggestion was at once put into practice by Mr. J. H. Brown, who had been placed in charge of the insects, and who also advised Mr. Markley to pursue a similar course. The heavy covering over the colony at Mr. McMullen's grove was not removed so soon, and as a consequence the insects did not do nearly so well. I made an examination about one month after the ladybugs were loosed and found the larvæ scattered over perhaps twenty different trees adjacent to the one upon which they were liberated, and while they were not so widely scattered at Mr. Markley's place they were much more readily found in numbers. Colonies were started at various points in the infested district by Mr. Brown during July and August in the same manner

that the first colony was established, the scales being practically cleaned up by the ladybugs and disease together by the last of September. The same disease that worked such havoc among the scales in 1899 was present in 1900, and some groves were almost cleaned up through its agency in the months of July and August, but since we were aware of its presence, and knew of its characteristic methods of attack, it did not greatly interfere with the colonization of the Novius.

I believe that the area of infestation has become sufficiently large to warrant the belief that the ladybug will remain permanently upon the field, despite the fact that, because of disease and other predaceous insects, the food supply is rendered very small during the autumn months. It is quite possible, if indeed not probable, that the chances for its permanent retention have been greatly increased by the failure to get it successfully established last summer.

CRUDE PETROLEUM EXPERIMENTS.

During the past year some experiments have been made with crude petroleum, used in varying strengths from 10 per cent to the pure material. Several hundred trees, including pear, plum, and peach, of many varieties were sprayed in the latter part of January and early February with the following results. Young trees of peach, plum, and pear seem to have survived the undiluted applications without much if any injury, while older trees were almost invariably injured, and bearing peach trees so treated were killed. Strengths from 10 per cent to 30 per cent were freely used without any apparent injury. My conclusions, so far as reached, may be summarized as follows.

That crude petroleum is a valuable addition to our list of insecticides; that the oil will remain on the trees for some weeks, and it can be plainly seen just what parts of the trees have been treated; that the oil will gradually spread a considerable distance from the spot where it has fallen; while it seems to possess some points of advantage over kerosene, I believe that it is quite possible that it will be found to deserve more cautious handling than has yet been suggested, as kerosene has proved to need in the past; I am unable to say it will be safe to apply undiluted petroleum to fruit trees of any description in Florida, and for the present would advise that only the diluted material be used, and that care be taken not to allow the liquid to collect at the bases of the trees. Banking the trees may sometimes be found useful, as in the case with using kerosene.

ORCHARD FUMIGATION.

Experiments have been instituted looking to the destruction of white fly in orange groves with hydrocyanic-acid gas under tents, and I contemplate carrying on more extensive work of this character the coming winter. The chief problem that is likely to arise, in connection with killing the insects, may lie in the fact that Florida dews are very heavy, so the process may have to be adapted to day conditions, instead of doing the work at night as commonly practiced in California. Since we have a considerable number of cloudy days in winter, the problem may not prove to be espepecially difficult. The greatest obstacle standing in the way of ultimate results from such treatment is that white fly does not confine itself to orange, but may be found scattered about upon wild trees in the hummocks, and upon undergrowth of various kinds in and about the groves; so granting that it were exterminated upon the trees, a pretty good crop of new bugs would have a chance to develop in the course of a season, and it seems that the best that can be hoped from fumigation work is that one treatment per year will give better and cheaper results than applications of other character.

MISCELLANEOUS.

Among the more important insects to which attention has been called by correspondents during the past eighteen months may be named the following: *Aspidiotus ficus*, the red scale, on oranges, Manatee, Fla.; *Aspidiotus juglans-regia*, the "gopher scale," on peach, Lake City; *Ceroplastes floridensis*, the white-wax scale, on oranges, at Ellenton, Palmetto, and Miami; *Lecanium hesperidum*, the "turtle-back" scale, from a number of widely scattered localities, nearly always upon oranges; *Dactylopius citri*, the mealy bug, upon oranges, pineapples, jessamines, roses, etc., very abundant and more than ordinarily injurious over a large part of the State this season (1900); *Diaspis bromeliæ*, the pineapple scale, serious at Braidentown, and received from Clearwater and a number of other localities; *Mytilaspis gloverii*, *Mytilaspis citricola*, and *Parlatoria pergandii* from nearly all sections of the citrous belt, especially on the west coast; the fig scale, *Asterolecanium pustulans*, has been received from Cutler.

The garden flea-hopper, *Halticus uhleri*, has done some damage to celery and ornamental plants at Lakeland and Tarpon Springs, and what I suppose to have been the same insect was reported at Bartow, though specimens were not sent to me. The pickle worm, *Margaronia nitidalis*, and the melon borer, *Margaronia hyalinata*, have been the subjects of inquiry from many quarters. The cucumber beetle, *Diabrotica vittata* and *Diabrotica 12-punctata* have been received several times during the past spring and seem to have been very troublesome in some localities. Curculio has stung a large percentage of the stone fruits the present year, the loss in the peach and plum districts being large. The bollworm, *Heliothis armigera*, is said by truck growers to have damaged tomatoes much more than usual this year. The warble fly, *Hypoderma lineata*, commanded some notice the past spring. The American Argas, *Argas americana*, was received from Cutler, where it was overrunning poultry.

Part of the material in this paper may be regarded as advance excerpts from the annual report of the entomologist to the director of the Florida experiment station.

The secretary then read the following paper by H. A. Morgan, of Louisiana:

Some Observations upon Artace Punctistriga.

In the fall of 1894 a few caterpillars and cocoons of this interesting insect were found upon old peach trees in the vicinity of Baton Rouge, La. At that time, and in fact until the fall of 1897, we were under the impression that this insect was an enemy to the peach and such other plants as it had been found upon. So impressed was the writer with this idea that in his report for 1895 he published a short article entitled "A new peach insect," in which leaf-eating habits were assumed, and arsenites recommended as possible remedies.

In October, 1897, while collecting, some 40 miles above Baton Rouge, a number of cocoons were taken in the vicinity of oak and peach trees attached to grass, fences, and small shrubs. Cocoons were also found upon the trunks and limbs of peach and white oak, indicating a prevalence that had not previously been discovered. The specimens were caged, and on November 14 a pair of moths emerged. On the morning of the 15th the female had deposited 160 eggs, none of which proved fertile. On November 18 the pair was found mating and on the morning of the 20th 152 fertile eggs were deposited, making in all 312 eggs. During a warm spell toward the end of January, 1898, all of the fertile eggs hatched, and it was by accident that the true feeding habits of this insect were then discovered. Along with a few peach leaves placed in the cage was a lichen-covered twig. The larvæ once finding the twig never left it. The droppings were an indication that food was being taken, and soon the complete disappearance of the entire outer roughness of the bark revealed the fact that a mistake had been made as to the food habits of the larva of this insect.

The gregarious habits of the young, the food, the fondness of the caterpillars for certain portions of the branches, and the protective coloration are all of peculiar interest, and no doubt have been the means of so successfully concealing the adult larvæ.

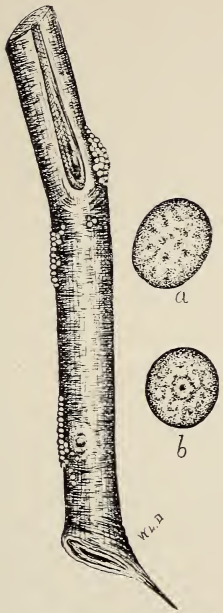
In many instances it is difficult to breed, or rather to rear, some species of insects, even when the best insectary facilities are available. The newly discovered food of the larva of this insect was at first found difficult to keep in a fresh condition, and a few of the larvæ died. This occurred in the cage containing those set apart for the determination of the different larval stadia, and being forced to complete the observations in the main cage, where the molts were more or less irregular, the data, as stated below, is subject to correction.

The first molt took place on February 10, the second on February 22, the third on March 9, and the last on March 24. The last larval stage was unusually long, for it was not until May 22 that the caterpillars began entering the cocoons, it being as late as July 17 when the last of the brood pupated. There was great irregularity in the growth of the larvæ, but this was perhaps due to confinement.

There are two broods per year and, as far as this section is concerned, the species hibernates in the egg condition.

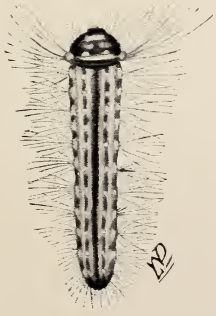
The male moth feigns death, and has been known to lie as long as two hours after being disturbed. The female has not been observed to possess this habit. The larvæ are interesting in that their color, form, and habits make them very difficult to observe. A cage containing many larvæ was several times shown students and visitors, and it was not without the closest examination that the specimens could be detected. The caterpillars fit so closely to the small twigs that the most successful method of collecting them is to take individual branches of a tree upon which a few cocoons may be found and run the hand carefully up and down each small branch.

The white cocoons attached to smooth, white pieces of oak bark are well protected,



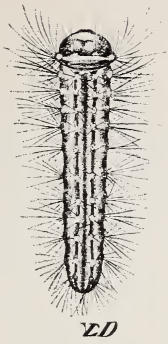
A

B

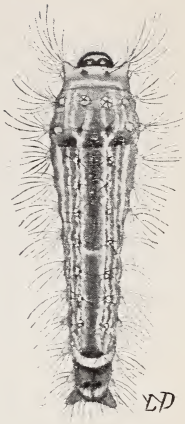


C

ARTACE PUNCTISTRIGA: A, EGG; B, ADULT LAYING EGGS; C, FIRST LARVAL STAGE.



A



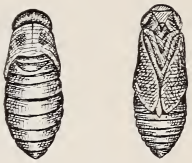
B

C

D

ARTACE PUNCTISTRIGA: LARVAL STAGES—A, FIRST STAGE; B, SECOND STAGE; C, LAST STAGE, DORSAL VIEW; D, LAST STAGE, VENTRAL VIEW.

A



B

C

D

ARTACE PUNCTISTRIGA: A, COCOON; B, PUPA; C, PARASITE EREMOTYLUS ARCTIÆ; D, PUPA CASE OF PARASITE.

and the moth, when at rest (not unlike the cocoon in shape and size), is likewise protected when in similar position.

Despite the advantage which the eggs, larvæ, cocoons (pupæ), and even the moths have by protective coloration, over 50 per cent of the larvæ collected were parasitized by a large ichneumon (*Eremotylus arctiæ*, Ashm.). Howard's *Encyrtus artacæ* has never been bred from specimens collected in this locality.

The accompanying illustrations (Pls. I–III) were made by one of my students, Mr. W. L. Denham, and represent fairly well the stages of this interesting insect.

C. W. Woodworth then presented a paper on "Entomological œcology."

S. A. Forbes was appointed a committee of one to confer with A. C. True, of the United States Department of Agriculture, regarding the selection of chairman and secretary for next meeting.

SECTION ON MECHANIC ARTS.

The Section on Mechanic Arts was called to order by President Murkland at 2 p. m., Tuesday, November 13. The minutes of the San Francisco meeting were read and approved. President Murkland read a report as chairman of the Section on Mechanic Arts to be presented to the general convention (see p. —). The report outlined a plan for creating a wider interest in the Section on Mechanic Arts, the prevailing thought throughout the paper being that the section should deal with questions relating more especially to the teaching of engineering rather than to the discussion of technical work. The report of President Murkland was approved by the section and he was authorized to present the same to the general convention.

W. E. Drake, of Rhode Island, read the following paper:

The Relation of the Agricultural and Mechanical College to the State.

At a former meeting of the Association it was suggested that the land-grant colleges should give uniform and similar courses of study, the idea being that as the colleges were all founded for one purpose, that purpose could best be carried out by similar courses. It is not necessary to again prove the fallacy of the above idea. The committee which reported several years ago on this subject recommended uniform and similar requirements for entrance to the land-grant colleges, and equal amounts of work for the degree of bachelor of science. The committee very wisely saw that any further attempt at similarity of work would not be possible.

The fundamental idea in the inception of the land-grant colleges was that each and every State and Territory in the Union should have its own college. It would have been a grand idea and noble work to have established one monster national college with free tuition, and along the lines of agriculture and mechanics. But far grander and bolder was the idea of giving a college to each State. Therefore the State is directly benefited by the college which it claims as its own, and it may reasonably be declared that the college shall be specially adapted to the needs of its own State, and that it shall have the greatest possible influence in its immediate locality. It is true that some of the State colleges have established courses and carry them out so well that students are attracted to the college from outside its own territory. Even where this is met with, the endeavor of the college should be first to meet the requirements and demands of the home State. The college should constantly fulfill its duty to the State by placing well-trained and amply-prepared men in the professions and industries carried on in that State. The students should be taught that they owe much to the State that has, from the very beginning, provided for their intellectual development. The graduate owes the State his or her very best service in developing its interests and contributing to its welfare and prosperity. Some State normal schools require two years of actual teaching in the State from their graduates.

The question is constantly coming to us, and should come to every college teacher, "How may the college be of the greatest value to the State?" Study the State, its industries, and its people. Arrange such courses of study as will prepare men for the work of the State. If the chief occupation is that of mining, give the course in mining a good opportunity to develop. Do not attempt to force a course where there

is no demand for it. Follow the demand of the people and educate that demand if it be necessary.

The study of local conditions is especially important if a teacher in one section of the country takes a position in another section. The course that was popular and successful in one section may not be the one needed in the other. Two men, one from Maine and the other from Georgia, meet at a school in the East and get into a discussion as to the best construction of a poultry house. The man from Maine thinks that the man from Georgia is a born fool because he can not understand the Maine plan of building to secure warmth and tightness. The Georgia man condemns Maine's foolishness in failing to appreciate the advantages in an open and airy style of construction. Neither of these men are fools, but good men each in his own place. Locality, climate, customs, and natural conditions have been ignored. It is only by consulting and making allowances for all of these that the teacher can hope to make the college of large value to the State.

The teacher may have the interests of the State thoroughly at heart and yet fail for various reasons to secure the results aimed at. State institutions always serve as a target for a certain class of politicians. There is always present the obstructionist who opposes every measure simply for the purpose of showing his power. Very peculiar things are done by some State colleges, and the only explanation which can be given is that there is politics in it. A prominent mining State drops a good course in mining from the curriculum of its State college. In a manufacturing State the professors of mechanics at the college are asked to keep very quiet, and not to push the department for fear of rousing the jealousy of the farmer voters. A third college spends the larger share of its resource upon an agricultural department when its students are all taking other courses. Such are some of the things which indicate that there is politics in it.

The managing board may be uninformed and inefficient. How many trustees are leaders in the work of the college that they manage? Often these boards act as a drag upon the institution and much coaxing and hard work must be done in order to keep the board itself in a progressive mood.

The people of the State may be ignorant or actually indifferent as to the aim of the college. The average person waits to be told in regard to what he ought to know without asking questions. The college with other ventures of the day must advertise and hustle for its business. By all means make the college catalogue plain and easily understood. Many colleges send out catalogues that are like Greek to a person of even more than ordinary ability.

Again, the competition of an older and firmly established institution may seemingly prevent the State college from developing to the point of its greatest usefulness. Usually the land-grant college, by reason of its free-tuition plan, will draw the student who can not afford to go to the older institution. The majority of the land-grant colleges will never become large colleges. We should therefore be content if we find ourselves teaching small classes, or if the institution attracts only those who would not go to a higher one. It is to be hoped that our colleges will never grow away from the class of young men and women that it was intended they should reach.

Education is a variable quantity. The age is changing day by day. The teacher strives to accomplish something to-day, and wakes to-morrow to find it no longer necessary. It may be, probably will be, that the land-grant colleges will necessarily change so much in ideals and methods that a few years will find them of an altogether different nature. The trade school, the industrial school, the correspondence school, the six weeks' school, and special schools for various crafts and arts are new in our system of education. Let us hope and see to it that we rightly read the signs of the times, so that we may keep the land-grant colleges in the front rank of useful schools, and thus be able to claim a deserved share in the remarkable development that the new era seems to be offering to this, our country, the United States of America.

L. S. Randolph, of Virginia, read the following paper:

A Course of Instruction in Mechanical Drawing.

In planning a course in mechanical engineering one of the most important items to be considered is the instruction in mechanical drawing. The following paper describes the method adopted by the writer in solving this problem, a brief statement of which would be as follows:

Having three courses—civil, mechanical, and electrical engineering—the instructions for all being under the jurisdiction of the department of mechanical engineering, for the freshmen and sophomore classes and for the junior class also, except those students in the courses of electrical engineering. In the senior year all instruction is given by the separate departments.

The subjects available for instruction may be classified as follows: Free-hand drawing and lettering; elementary mechanical drawing; machine drawing; kinematics; machine design.

In free-hand drawing no attempt is made at artistic excellence, but only such work as will give the student such facility with his pencil to enable him to make a good free-hand sketch or to letter or dimension a drawing neatly. We are constantly receiving replies from those of our graduates who are in drawing-rooms that they are getting along very nicely, but have great difficulty in lettering neatly.

Elementary mechanical drawing includes the construction of curves, drawing of simple forms, the theory and practice of projections, and pen shading.

Machine drawing includes the sketching and drawing first of the details and then of the assembled machine. The sketches being made first, fully dimensioned and arranged as they are to show on the drawing. The drawing is then made from these sketches. The instruction follows as closely as possible along the lines of good drawing-room practice.

Kinematics includes the study of the theory of motions, but does not include valve gears.

Machine design includes the design of a machine with especial reference to the calculations of the parts and a determination of stresses involved and the areas necessary.

There was another condition imposed which should be mentioned here. The institution draws a large number of its students from those walks of life where financial conditions are not always the best, and in consequence a large number of our young men drop out after a year or two, and it is therefore advisable to give as well-rounded a course to those men as possible, or a course which will enable them to have as high an earning capacity as possible.

The work of free-hand drawing and lettering is, the writer is aware, frequently brought in in the higher classes, but it has always been a debatable question whether this was wise. Is it not better to use free-hand drawing as an introduction to mechanical than vice versa? As free-hand drawing was needed in other courses than engineering, and the only available time they had for it was the first term of the freshman year, it was placed there. The experience of two years has led us to believe that the selection was a wise one. It makes a most excellent preparation for mechanical drawing, which immediately follows it. The preparation is so good that we obtain the same amount of work, or rather the same advancement in the freshman year now as when the whole year was given up to mechanical drawing. A great improvement in lettering and figuring was not the only gain, but a considerable degree of neatness promptly attained was the principal advantage.

Probably the most difficult thing to decide was the relative position of kinematics and machine drawing. It may be claimed that kinematics should not be taught in the drawing-room, but for many reasons it was necessary here to teach it in the drawing-room, and the problem presented was, Should it go in the junior class, with machine drawing in the sophomore, or vice versa?

The reasons for putting kinematics in the sophomore year may be stated as follows:

(1) The subject can be readily handled with the mathematical preparation which the student has.

(2) It would seem to be the logical arrangement following immediately after the study of projections.

(3) With intricate machinery it is difficult to make a drawing without a knowledge of kinematics.

The reasons for putting the instructions in kinematics in the junior year and machine drawing in the sophomore year, were the following:

(1) Kinematics could be somewhat better handled in the junior year on account of better preparation in the higher mathematics.

(2) The instruction of students in machine drawing in the sophomore year would put those who left the drawing-room at this time, including both those who left the college and those who went into electrical engineering, in better shape for practical work than if machine drawing were not taught here.

(3) The student when taught to make a drawing of a machine can better appreciate and apply the principles of mechanism as he goes along.

For the last two reasons machine drawing was placed in the sophomore year and kinematics in the junior year. A two-years' trial of the system leaves us well content to let it stay there.

Machine design comes naturally in the junior and senior years, and must come after the work in the class room on strength of materials, or at least alongside of it. We hope this year to have machine design started while the class is still working on strength of materials.

The methods of instruction were as follows: In free-hand drawing Langdon S. Thompson's system is being used, with some drawings from nature.

In elementary mechanical drawing the work is, as previously stated, confined to curves, projections, and the simplest elements.

In machine drawing a method has been used for the past two years which has given excellent results. The machine and its parts are placed on a table in the center of the room and each student sketches up in a book of cross-section paper those parts assigned to him. These sketches are free-hand, and are dimensioned and arranged as the completed drawing is to be dimensioned and arranged. It is impressed upon the student that he must make as few trips as possible to the machine for omitted dimensions. From these sketches the drawing is made and completed.

The principal advantage is that the sketches are criticised and corrected both as to arrangement of views and dimensioning before the work has been put on the board, with a consequent saving of about nine-tenths of the time required to make such corrections on the board.

All of this work is made to conform as closely as possible to ordinary drawing office practice, even to putting on of titles, borders, and reference numbers. Several drawings of average worth are selected at the end of the year and sent to specialists for criticism.

In grading the work the amount of work a man accomplishes during the year is recorded and a certain amount must be accomplished before the man can be passed. The character of the work is also graded, and upon these two the term grades are made.

The student knows that a certain amount of work of good character must be completed in order to pass, and in consequence he must work to come up to it. The result being that much less difficulty is experienced in keeping order and making the men work; one man handling six to eighty men readily.

The time given to each course is as follows:

Course in mechanical drawing.

Subject.	Hours per week.	Number of weeks.
Free-hand drawing	6	15
Elementary mechanical drawing	6	18
Machine drawing	9	18
Kinematics	6	15
Machine design:		
Junior	6	18
Senior	6	15

While the course is working well, the writer is in doubt as to many points, such as the advisability of handling kinematics in the class room rather than in the drawing-room.

The object of the paper is as much to obtain criticism as it is to impart information, and it is hoped that such criticisms will be freely made.

In closing, the writer wishes to acknowledge his indebtedness to Mr. W. H. Rasch, assistant professor, to whose ability and untiring energy so much of the success of the work is due.

J. D. Hoffman, of Indiana, read the following paper:

The Student of Mechanic Arts, an Apprentice.

Much has been written concerning the recognition that the graduates of our technical schools should receive from the shops and industries of the country as a result of their practical training and instruction in the schools. Some of this, to be sure, has been of great value, showing the trend of the professional engineering mind; but many of the writers, if they are to be judged from their publications, seem to believe that the product, whether animate or inanimate, of any educational institution is far inferior to that produced through the busy marts of trade.

Exceptional cases where the graduate student falls short in some special work assigned to him may sometimes give rise to biased views, but why this should lead to a universal condemnation of the student mechanic body is hard to fathom.

From all I have heard and read it seems to me that some phases of the subject have been overlooked and that not all parties concerned have received justice.

The central point of attack is the apparent inability of the schools that teach mechanic arts to turn out machinists, pattern makers, foundry men, and other tradesmen who are, at the time of completing their course, skilled workmen.

Before attempting further discussion on the subject it would be well to make a few statements upon which this paper will be based:

(1) A growing popular sentiment that the mechanic should not only be able to do his work in a scientific manner, but should understand the principles involved in the doing of that work.

(2) A desire on the part of the young man to secure a good education at the same time he is pursuing his trade.

(3) That the purely trade school accomplishes the above with the evident purpose of fitting him for some one of the many trades.

(4) That the technical school does not lay any special stress upon any one of the trades, but gives a good working basis in all of the trades, emphasizing the foundation principles of a general engineering education.

In the following I wish to speak of the technical school and of the shop as training places where a young man may educate himself in the line of general mechanical work. They should not be considered antagonistic, but mutually helpful to each other, since both are endeavoring to turn out men who are of the highest possible shop value.

A proper comparison of the student and the apprentice, of course, can hardly be made, on account of the training of each running along such dissimilar lines. The student, with his fair experience in many lines, should not be called upon to stand an examination in only one subject in competition with a man practiced thoroughly in that special feature, and yet in many cases this is done and he is told he is inferior to the shop-trained man. That he is not an expert with tools will readily be admitted, for by continued application to any one operation is skill acquired; but to say that the training which the student receives is inferior to that he would have received in a shop can not be substantiated. Examination as to his fitness as a shop man should not be conducted along any one line, but on various lines, in which case he presents an entirely different appearance. I claim that he not only receives largely an equivalent practice in shop methods, but much more that goes to make him a valuable member in any working force and which can not be obtained in the shop.

It must be admitted that the apprentice system has come to be very much demoralized of late years, and in fact discarded altogether in many of the larger establishments, where the workmen are known as specialists. These men, who usually work on the piecework plan, bend all their energies of thought and action toward the rapid production of the specialty they have in charge. The rate of wage is so arranged that it requires all his time in actual production, so that little if any time is given him to observe operations of a different nature from his own. It is an exception where an apprentice, or, properly speaking, "a boy who signs to learn a trade," is given a variety of work. He is generally given a term of three years, and in that time is practiced on the use of three or four machines, if he is fortunate. In all probability he will be more useful to the firm if kept on one machine, and there he will stay unless some extra pressure be brought to bear upon the management. At the close of his apprenticeship he is a very skillful operator on those machines actually operated by him, and has more or less knowledge of the operations performed in his presence, but of which he has had no part. The same can be said of apprentices assigned to the erection of machinery. They become very proficient in the use of the chisel and file, and are well trained on the construction of certain styles of machines, but their knowledge of the operation of machinery is necessarily very limited. A man so trained will feel very much at home if when seeking employment he is given work of a similar nature to that upon which he has been trained, but very much at sea if given a job which requires the use of his own inventive genius. Again, if he feels at a loss concerning the work in his own trade, what can he do with an operation which requires some knowledge of the allied trades? As, for example, a machinist should know the principles of forging and be thoroughly acquainted with the strength of materials. A pattern maker should understand the principles underlying the operating of machines, and be a good designer of machines as well as a good molder. A successful foundry man should be a metallurgist, molder, and pattern maker, and so on down the list of trades. It might be said of any of the so-called trades that some of the very foundation principles are borrowed from some of the other trades, and a workman will do his best work when he is enlightened as to these points of common interest.

The skilled mechanic of the twentieth century has come to mean more than the person who can merely duplicate work after the plans of others. He must be one who has the knowledge and ability to plan for himself. The workman who has a

general training is of more value to his trade, even though in some operations he is not as skillful, than the one who has been forced to specialize. A case of this kind was brought to my notice a short time ago. A man who employs mechanics wished to get "a good all-around man," and because there were no graduates available at the time, applied to the superintendent of a large establishment to supply one. The superintendent said: "I am very sure I have not one man in my employ who could fill the place except my foreman, and I should not like to let him go. The men are all specialists, you know, and would not be of much account on work of a general nature." At the time this request was made there were more than 300 men in his employ, and, as commonly understood, these men are considered skilled mechanics.

Specialty work seems to be on the increase, and the fact that this is so proves to be a detriment to the cause of the apprentice. It puts an effective barrier between him and the fulfillment of his ambition, and he is obliged to look to other sources for his mechanical training. In my estimation this is not a pessimistic view. We must take the facts as we find them and solve the problem accordingly. I believe that every young man who begins an apprenticeship hopes at some future time to be able to fill a position higher than that of "machine hand" or "vise hand." Such being the case, surely the greatest variety of work, embodying the greatest number of mechanical principles, is not only desired but should be demanded for him. This general training can be obtained more satisfactorily at a trade school or a technical school, the latter having more in view the harmonizing of the different trades to each other, thus forming a solid basis for continued investigation in the higher forms of mechanics known as engineering.

The technical school was inaugurated for the purpose of giving inventive capacity to the mind as well as skill and dexterity in handicraft. The advocates of the school insist that to be a skilled mechanic one must see the reasons underlying each successive step, and that intelligence of action and skill of manipulation go hand in hand. The theoretical and the practical should be blended together. Necessarily, then, some of the skill in the art of handling the tools is sacrificed to the time given over to instruction. No claim is made that the graduate can turn screw threads as fast as a man who has served his entire apprenticeship of three or four years as a lathe hand, or that he can chip and file a surface as quickly and as well as a vise hand of several years' experience, but rather that he will take a job from its inception and carry it through the various lathes, planers, grinders, shapers, drills, etc., to completion, and will keep alongside and possibly a step ahead of the man who has had the benefit of the training usually given to the average apprentice.

It must be granted that in every new enterprise, or in every radical departure from an old enterprise, it requires much time in which to perfect the method of operation so that there will result the greatest economy. The school shop is of recent origin and has had many serious inconveniences with which to contend, not the least of these being the contempt of the practical man who has had his entire training in a shop. The objections brought forth, when traced to their origin, seem to be founded upon a complete ignorance of the methods and interior workings of the department of "practical mechanics" as found in our engineering schools. It is true that there are imperfections and discouraging features, not all of these having yet been eliminated, but to the reasonable mind that has had contact with the atmosphere of both the "shop" and the "school shop," the advantage must surely rest with the latter. Time in which to properly develop the work is very important. The course of instruction must be tried and additions and subtractions made until the greatest amount of shop methods can be shown in the limited time at the disposal of the student.

In speaking of the limited time of the student I do not do so in a criticising way; rather, I believe that the time of the apprentice actually used in acquiring skill and information could be crowded into half his shop hours, if the work of the shop could be systematized to that end. Unfortunately the objects of the employer and the apprentice can not harmonize to any great extent. The one wants service and the other information. Wherein their wants differ the apprentice must make the concession. Looking at it from this standpoint the student is receiving shop instruction and skill during a number of hours which compares favorably with that of the apprentice.

The technical school, however, with its shops and laboratories, makes an ideal training place, and so fits any young man that he may follow the trades if he so chooses, or he may select one of the many phases of engineering, there being constant demand for men along these lines.

Concerning the courses for technical instruction, I trust I may be pardoned for mentioning the institution with which I am connected (Purdue University), for by so doing I can speak from my own experience and observation.

The instruction in practical mechanics, as given at present, is so arranged that the different operations follow in sequence. Skill is acquired in the performing of exercises, and as each new exercise is to present some new feature of instruction, the student is made acquainted with a wide range of work which necessarily requires his closest attention at all times. He is given the material, with instructions for doing the work, and is required to bring in the finished piece as nearly perfect and in as short a time as it is possible for him to produce it. Quantity is at first sacrificed to quality, but as the work progresses he is given jobs to do in duplicate lots, which teach him to work against time. If it is thought the student has not done himself justice in the first attempt the exercise is made again.

As the work goes on and the student becomes proficient in the use of the tools, other work embodying the same principles may be substituted for the exercises. For example, in the machine shop this substitution may be the making of repairs and improvements on machines now in use in the laboratories, the making and assembling of new machine parts, and the building of jigs and tools used in machine construction. In the wood shop, cabinet cases, writing desks, patterns for machines, and various appliances are designed and made. The foundry and forge room supply all the necessary castings and forgings.

The departments all work in harmony with one another, and it is found that enough work of the character described is needed to satisfy the different departments without manufacturing for the public. The schools are continually in need of articles of such a character that they make ideal school-shop products.

This element of manufacturing brings the student in touch with transactions of a business nature. A schedule of raw-material values is furnished the student. On completing a piece of work he is required to state on his time sheet the amount of material used, giving its market value; also the estimated value of his product, figuring his time at a certain rate per hour. This may then be compared with the estimate of similar manufactured articles, and in this way he is able to judge whether he could compete with other producers. The conditions are brought as nearly as possible to conform to general shop conditions, and the student is doing actual shop service, as though he were working for a manufacturing firm.

One of the criticisms brought out recently in a paper before an engineering society was to the effect that "The students in our engineering schools readily receive the impression that they are not required to do the work themselves, but that it is only necessary to know how it should be done by others." This statement can scarcely be justified, as I believe it is the policy of institutions of this kind to require more rigid courses in shop practice than ever before. Take, for example, the daily duties required of the students in the foundry. They report for roll call and assignments. If it is molding day they are detailed to the following: Molding, core making, lining ladles, making, facing and cleaning, and lining the cupola. If, however, it is the day for a heat, the men are assigned to other duties, such as: Ladle carriers, skimmers, cupola tenders, chargers, and floor manager. When the molds are filled they all fall to, to clean up their floors, piling the castings and covering them with sand until the next day when they are rattled, cleaned, and taken to the machine-room. From 60 to 75 per cent of the castings can be used, the average amount poured being from 1,600 to 2,000 pounds. In the routine described the assignments change from day to day, thus enabling the student to become acquainted with general foundry work. The work is all done by the students, the instructor being present to direct, but not to do the work.

Let it not be understood that we claim that a man who has passed through a course of training in one of our schools is an expert in the subjects taught. But it is claimed that he has (1) a good foundation upon which to build and a stimulus to succeed; (2) a fair degree of skill in the use of machinery and methods in the various trades; (3) a knowledge of the action of matter under different conditions of use; (4) a good education in those subjects which makes him a valued member of society. These qualities when acquired by any man will cause him to make his mark.

The demands for men at present prove that he has so far been successful, and the statement that the technical graduate is falling into disrepute is not well founded. The call for men to fill positions of trust, in almost all lines of engineering work, has been greater this year than ever before. and many positions could not be filled for want of men.

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